Supplemental Draft
Environmental Impact Statement

ASARCO, INCORPORATED'S
ROCK CREEK PROJECT

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U. S. Forest Service
Kootenai National Forest

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Environmental Quality

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COVER SHEET

Type of Statement: Supplemental to the Draft Environmental Impact Statement

Proposed Action: Construction and operation of ASARCO, Incorporated's (ASARCO) Rock Creek Project

Lead Agencies: Kootenai National Forest
Montana Department of Environmental Quality

Cooperating Agencies: U.S. Army Corps of Engineers
U.S. Environmental Protection Agency
Idaho Department of Health and Welfare

Abstract: ASARCO's Rock Creek Project Supplemental Draft Environmental Impact Statement describes the land, people, and resources potentially affected by the proposed Rock Creek copper/silver mine. The major federal and state action consists of the approval of all necessary permits to construct and operate the Rock Creek Project. The proposed project would consist of seven primary components: an underground mine, a mill, four adits and portals, a tailings impoundment, access roads, a 6.9-mile utility corridor, and a rail load-out. A new alternative is analyzed in detail and the no action and ASARCO alternative are summarized.

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PREFACE

An EIS is not usually read like a book, from chapter one to the end. The best way to go about reading an EIS depends on where your interests lie. You may be more interested in impacts, while others might have more interest in the details of the proposed plan, or be more concerned about what opportunities were made available for the public to be involved in the environmental assessment process. Many readers probably just want to know what is being proposed and how it will affect them.

This document is a supplement to the draft EIS released in October 1995. Both NEPA and MEPA (§1502.9(c) CFR and §17.4.621 ARM respectively) identify the reasons that drive the preparation, release, and review of a supplemental EIS. Both regulations require one if there is a "substantial change in the proposed action" or if there are "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action and its impacts." MEPA also requires a supplemental if "following preparation of a draft and prior to completion of a final EIS, the agency determines that there is a need for substantial, additional information to evaluate the impacts of a proposed action or reasonable alternatives."

ASARCO has not proposed any changes to its proposed mine permit application for the Rock Creek Mine. However, the Agencies determined new information obtained in preparing responses to the draft EIS was either substantive new information or would result in a substantially new agency alternative that needed to be presented to the public for review and comment prior to the final EIS. A change in analysis methods and more accurate methods of mapping electronically have also affected impact analyses. The supplemental EIS presents a new alternative along with some new resource information which affects impact analysis and might have some bearing on the decision to be made after the final EIS is published. The supplemental EIS focuses on comparing the new alternative, Alternative V, Tailings Paste Disposal, to alternatives I and II (§17.4.621(2)(b) ARM) and displays new information which modifies analyses for Alternatives I through IV for some resources. The reader must refer to the draft EIS for those portions of the supplemental EIS that are summarized in alternatives I through IV and for more detailed discussion on the resources in Chapter 3.

This document follows the format established in the National Environmental Policy Act and the Montana Environmental Policy Act regulations (40 CFR Parts 1500-1508 and ARM 26.2.601-663, respectively). The following paragraphs outline information contained in the chapters and appendices of this supplemental EIS so that readers may find the parts of interest without having to read the entire document.

- **Summary:** contains a short, simple discussion to provide the reader and the decision makers with a sketch of the more important aspects of the supplemental EIS. The reader can obtain additional, more detailed information from the actual text of the draft and supplemental EISs. The summary for the Proposed Rock Creek Project supplemental EIS is a separate, stand-alone document which is paired with the supplemental EIS.

Chapters 1 through 4 are found in Volume 1 of the supplemental EIS for the Rock Creek Project; Chapters 5 through 9 and the Appendices are found in Volume 2. The chapters are briefly described below:

- **List of Abbreviations and Acronyms:** This list describes the abbreviations and acronyms used throughout the EIS.

- **Chapter 1 - Purpose and Need for the Action:** describes the proposed action, purpose and need for the action and the EIS, project area, agency roles and responsibilities, decisions to be made, and public participation.

- **Chapter 2 - Description of Alternatives:** describes the significant issues associated with the proposed action and the development of alternatives as they relate to Alternative V. It summarizes the pertinent components of the proposed action, the no-action alternative, and two agency alternatives described in the draft EIS and contains a detailed description of a new alternative, Alternative V. Other alternatives that were considered but dismissed are identified along with rationale for not including them in the analysis. Reasonably foreseeable activities in the vicinity of the proposed project are identified. This chapter also provides a comparative analysis of the environmental impacts of the alternatives to provide a clear basis of choice among options for the decision maker and the public. The lead agencies' new preferred alternative is identified.

- **Chapter 3 - Affected Environment:** summarizes the present condition of the environment that would be affected by the proposed action and alternatives. Substantive new information obtained since the draft EIS was released has been included for some resources.

- **Chapter 4 - Environmental Consequences:** describes the probable impacts to the human environment that would result from developing the proposed action or the new alternative~~s~~, including cumulative impacts, short-term uses versus long-term productivity, unavoidable impacts, and irreversible or irretrievable impacts. Impacts for alternatives II and IV are only included if new information or analysis methods changed the analysis contained in the draft EIS.

- **Chapter 5 - Consultation With Others:** lists the agencies, companies, and organizations consulted as well as the cooperating agencies.

- **Chapter 6 - Preparers and Contributors:** lists the people involved in the research, writing, and internal review of the draft and supplemental EISs.

- **Chapter 7 - Distribution and Review of the EIS:** lists agencies, organizations and individuals who received a copy of the supplemental EIS.

- **Chapter 8 - Glossary:** describes the technical terms used in the supplemental EIS.

- **Chapter 9 - References Cited:** lists the references cited in the supplemental EIS.

- **Index:** contains cross-references and identifies the pages where key topics can be found.

- **Appendices:** contain key supporting documents for the supplemental EIS. If the documents are present in both the draft and supplemental EISs, the version in the supplemental EIS has been revised since the draft EIS was released. The following appendices are contained in either the supplemental or draft EIS or can be found in both EISs:

  — Appendix A: Definition of Significance in NEPA/MEPA (draft EIS)
  — Appendix B: Draft Biological Assessment (draft and supplemental EISs)
  — Appendix C: Preliminary Section 404(b)(1) Showing (draft and supplemental EISs)

— Appendix D: Public Comments and Concerns (draft EIS)
— Appendix E: Tailings and Subsidence (draft EIS)
— Appendix F: Description of Reagents (draft and supplemental EISs)
— Appendix G: Revegetation Plans (draft EIS)
— Appendix H: Agencies' Conceptual Monitoring Plans (draft and supplemental EISs)
— Appendix I: McKay Creek Alternative Description (draft EIS)
— Appendix J: Revised Preliminary Determination Air Quality Permit (supplemental EIS)
— Appendix K: New Management Area Descriptions (supplemental EIS)
— Appendix L: Failure Modes Effects Analysis (supplemental EIS)
— Appendix M: Tentative MPDES Permit Fact Sheet and Statement of Basis (Revised) (supplemental EIS)
— Appendix N: ASARCO's Wetlands Mitigation Plan for Alternative V (supplemental EIS)

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LIST OF ACRONYMS AND ABBREVIATIONS

AAA	American Automobile Association
ABA	acid base accounting
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
AIRFA	American Indian Religious Freedom Act
NP/AP	neutralization potential/acid potential
ARM	Administrative Rules of Montana
ASARCO	ASARCO Incorporated
BA	Biological Assessment
BAA	bear analysis area
BLM	Bureau of Land Management
BMP	best management practices
BMU	bear management unit
BPA	Bonneville Power Administration
CEM	cumulative effects model
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMW	Cabinet Mountains Wilderness
COE	U.S. Army Corps of Engineers
const	construct/construction
cu	cubic
cy	cubic yard
dBA	decibels, A scale
DEQ	Montana Department of Environmental Quality
DFWP	Montana Department of Fish, Wildlife and Parks
DHES	Montana Department of Health and Environmental Sciences
DNRC	Montana Department of Natural Resources and Conservation
DSL	Montana Department of State Lands
EIS	environmental impact statement
elev	elevation
EPA	U.S. Environmental Protection Agency
et seq.	and the following
FDR	forest development road
ft./day	feet per day
gpm	gallons per minute
GVW	gross vehicle weight
HD	hunting district
HRT	hydraulic residence time
hwy	highway
ID	Idaho
IDEQ	Idaho Department of Environmental Quality
IDNHP	Idaho Natural Heritage Program
IDT	interdisciplinary team
ISC	Industrial Source Complex
KNF	Kootenai National Forest
kV	kilovolt

kW	kilowatt
kWH	kilowatt hours
LAD	land application disposal
MA	management area (in Forest Plan)
MAC Report	Mineral Activity Coordination Report
MCA	Montana Codes Annotated
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
mg/L	milligrams per liter
mi	mile
MPDES	Montana Pollution Discharge Elimination System
MPH	miles per hour
MRL	Montana Rail Link
MSHA	U.S. Mine Safety and Health Administration
MT	Montana
MTNHP	Montana Natural Heritage Program
NAGPRA	Native American Graves Protection Act of 1990
NEPA	National Environmental Policy Act
NFS lands	National Forest System lands
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
ORD	open road density
PMF	probable maximum flood
ppm	parts per million
PPSM	paste production storage mechanism
PSD	prevention of significant deterioration
psi	pounds per square inch
PVC	polyvinyl chloride
$Q_{7,10}$	7-day, 10-year low flow
QA/QC	quality assurance/quality control
RD	ranger district
ROD	record of decision
ROS	Recreational Opportunity Spectrum
SHPO	State Historic Preservation Office
TDS	total dissolved solids
TMDL	total maximum daily load
TSL	traffic service level
TSP	total suspended particulates
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMS	Visual Management System
VQO	visual quality objective
WWP	Washington Water Power

SUMMARY OF THE ASARCO ROCK CREEK PROJECT SUPPLEMENTAL EIS

INTRODUCTION

This summary presents a condensed version of information contained in the supplement to the draft Environmental Impact Statement (EIS)[1] for the ASARCO Rock Creek Project. The supplement is needed because there is substantial, additional information that has been collected that may change the basis for the Agencies' decisions regarding the Rock Creek Project. ASARCO Incorporated's (ASARCO) proposed action -- the construction and operation of the Rock Creek Project -- and one new alternative have been analyzed in this supplemental EIS. Alternatives III and IV remain as described in the draft EIS. If interested in more detailed information, one may review the supplemental draft EIS. The supplemental EIS, the draft EIS, or its summary can be obtained from the following people:

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Kootenai National Forest
506 U.S. Hwy. 2
Libby, MT 59923
(406) 293-6211

Kathleen Johnson
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-1760

A copy of this supplemental EIS and the draft EIS can be reviewed at the following locations or via the Internet at the DEQ web page (http://www.deq.mt.gov/eis.htm):

Supervisor's Office, Kootenai National Forest, Libby, MT
Cabinet Ranger Station, Trout Creek, MT
Montana Department of Environmental Quality, Helena, MT
Montana Department of Health and Environmental Sciences, Helena, MT
Montana State Library
U.S. Corps of Engineers, Helena, MT
Mansfield Library, University of Montana, Missoula, MT
Lincoln County Library, Libby, MT
Missoula City-County Library, Missoula, MT
Thompson Falls Library, Thompson Falls, MT
Heron Library, Heron, MT
Noxon High School Library
East Bonner County Library, Sandpoint, ID
Clark Fork Library, Clark Fork, ID
Coeur d'Alene Public Library, Coeur d'Alene, ID

[1] Hereinafter the "supplement to the draft EIS" will be referred to as either the "supplement" or "supplemental EIS."

THE EIS AND PERMITTING PROCESS FOR THE ASARCO ROCK CREEK PROJECT

The ASARCO Rock Creek Project is a proposed underground copper and silver mine in northwestern Montana. The project is proposed and would be operated by ASARCO, Incorporated (ASARCO). The mine, mill, and other facilities would be located in Sanders County, Montana, near Noxon, Montana (see **Figure S-1**). ASARCO currently holds mineral rights under the Cabinet Mountains Wilderness (CMW). The purpose of the proposed action is to develop these interests. The project would include constructing a mill for ore processing and associated mine waste disposal facilities. A rail load-out for transportation of concentrate, and water treatment facilities would also be built.

Procedures governing the EIS analysis process in Montana are defined in administrative rules implementing the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA). These laws require an EIS to be prepared if any action taken by the State of Montana or the U.S. Forest Service may significantly affect the quality of the human environment (as defined in NEPA and MEPA). The draft EIS was written to meet the requirements of these statutes and the administrative rules and regulations implementing these laws adopted by participating state or federal agencies.

Two governmental agencies serve as lead agencies for this EIS: Kootenai National Forest (KNF) and Montana Department of Environmental Quality (DEQ). The EIS was prepared in response to applications to operate the ASARCO Rock Creek Mine submitted to KNF and DEQ. One other agency will use this EIS to make decisions on permits it issues. The U.S. Army Corps of Engineers (COE) will make a determination on ASARCO's 404 permit.

The scope of the supplemental draft EIS includes actions, alternatives, and analyses that would be considered in separate EISs required by each agency in order to fulfill its regulatory responsibilities. Preparation of a single draft EIS for the Rock Creek Project provides a coordinated and comprehensive analysis of potential environmental impacts. The decision to be made by each agency is to grant or deny the necessary permits or approvals for ASARCO to operate the Rock Creek Project. Permitting decisions will be based on the environmental effects and consequences relative to legal standards as documented in this EIS, along with other information presented during agency decision-making processes. In addition, this information will be used to determine the conditions necessary to operate the project, if approved.

DEVELOPMENT OF ALTERNATIVES

In an EIS, the Agencies are required to evaluate the environmental effects of the proposed action and reasonable alternatives to it. The Agencies must also consider a no-action alternative. Alternatives other than the proposed action and the no-action alternative were developed by the Agencies in response to identified environmental issues.

Public participation has been a key element in preparing the draft EIS as well as this supplement to the draft EIS (see **Table S-1**). The first opportunity for public involvement occurred in the beginning of the EIS process when "scoping" was conducted. Scoping is a process designed to identify a broad list of environmental issues related to the proposed action. Scoping was again conducted when preparation

FIGURE S-1

of the EIS was resumed after a 4-year lapse. The Agencies determined significant issues from those identified during the two scoping periods. The subsequent analyses presented in this EIS focus on the identified significant issues.

Meetings and hearings were held for public participation on the draft EIS and the draft MPDES permit. Approximately 2,000 comments were received on the draft EIS and draft MPDES permit. Additional information was obtained as a result of public comments. Agency review of this information has resulted in the need to prepare and submit a supplemental EIS for public comment and review prior to preparation and release of a final EIS.

TABLE S-1
Public Meetings

May 26, 1987	Public information meeting held on ASARCO's application in Noxon, Montana
January 27, 1988	Public scoping meeting on ASARCO's application at Noxon, Montana
March 22, 1990	Public meeting on ASARCO's petition to amend ambient water quality at Noxon, Montana
June 16, 1993	Public scoping meeting in Noxon, Montana
June 28, 1993	Public scoping meeting in Sandpoint, Idaho
October 5, 1995 to December 5, 1995	Public comment period on draft EIS
November 14, 1995	Open house and public hearing on draft EIS in Noxon, Montana
November 15, 1995	Open house and public hearing on draft EIS in Sandpoint, Idaho
February 20, 1996 to April 22, 1996	Public comment period on draft MPDES permit and water-quality related portions of draft EIS
April 8, 1996	Public meeting on draft MPDES permit in Noxon, Montana
April 9, 1996	Public hearing on draft MPDES permit in Noxon, Montana
April 10, 1996	Public meeting on draft MPDES permit in Sandpoint, Idaho
April 11, 1996	Public hearing on draft MPDES permit in Sandpoint, Idaho
April 22, 1997	Public town meeting in Sandpoint, Idaho, to discuss new alternatives in supplemental EIS
April 23, 1997	Public town meeting in Noxon, Montana, to discuss new alternatives in supplemental EIS

Based on the range of environmental issues identified by the public during scoping and analysis by DEQ and KNF, eight significant issues drove the development of alternatives and evaluation of impacts:

Issue 1: Effects on quantity and quality of Montana and Idaho surface and ground water resources.

Issue 2: Effects on fish and wildlife and their habitats and current and proposed threatened and endangered species.

Issue 3: Stability of the tailings impoundment/paste facility.

Issue 4: Impacts to socioeconomics of surrounding communities.

Issue 5: Effects on old growth ecosystems.

Issue 6: Effects on Waters of the U.S. and wetlands.

Issue 7: Effects on public access and traffic safety.

Issue 8: Effects on aesthetic quality, including noise, scenic, and wilderness experiences.

A number of alternatives suggested during scoping have been determined by the Agencies to be infeasible or otherwise unreasonable. Dismissed alternatives relative to the supplemental EIS fall under the five topics listed below: Additional alternatives considered but dismissed are covered in Chapter 2 of the draft EIS.

- mill and mine portal siting alternatives;
- tailings paste deposition siting alternatives;
- other tailings disposal methods, including backfilling;
- lined tailings disposal facility;
- dry tailings backfill transportation method;
- rail siding (loadout) alternatives; and
- alternate water treatment methods.

ALTERNATIVES DISCUSSED IN THE SUPPLEMENTAL EIS

Four alternatives were carried forward for consideration in the draft EIS. One additional alternative is being considered in this supplemental EIS. The no-action alternative (Alternative I) and ASARCO's proposal (Alternative II) have been included in the supplemental EIS for comparison purposes and as required by MEPA (17.4.621(2), MCA). **Table S-2** provides side by side comparison of the components of the action alternatives. Brief descriptions of the alternatives follow:

Under Alternative I, the no-action alternative, the project would be denied or bought out by public agencies. The no-action alternative provides a baseline for estimating the effects of other alternatives.

Alternative II is ASARCO's proposed plan (**Figure S-2**). ASARCO would construct, operate, monitor, and reclaim the Rock Creek Project as proposed in the plan of operation and application as well as its air quality permit application and MPDES permit application. The Agencies would issue the necessary permits and approvals.

Alternative III consists of Agency-initiated modifications to ASARCO's mine proposal (see the draft EIS for alternative description) (**Figure S-3**). The changes include modifications to some facility locations and impoundment construction as well as mitigations proposed by the lead agencies to reduce or eliminate undesirable environmental impacts and increases the surface disturbance to 609 acres (see **Figure S-3**). These mitigations are in addition to or instead of mitigations proposed by ASARCO.

TABLE S-2
ASARCO Rock Creek Project Alternative Comparison

Project Facility or Feature	Alternative II ASARCO Proposal	Alternative III Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V Paste Backfill & Alternative Water Treatment
Mill Site	Upper end West Fork Rock Creek	Same as Alternative II	Confluence of East and West forks Rock Creek	Same as Alternative IV
Tailings Impoundment	Rock Creek site 325 feet high, 324 acres, upstream construction	Same as Alternative II except modified centerline design w/technical review panel	Same as Alternative III	Same location at Alternative II but utilizing paste
Adit Waste Rock Dump	Southeast of adit 600,000 tons	Above mill site 600,000 tons, some used to create millsite	No waste rock dump. 1,000,000 tons used to create mill site and starter berms	Same as Alternative IV
Mine Adit, Length & Grade (to underground crusher)	Up Chicago Peak Rd (FDR No. 2741) 9,000' @+12.7%	Same as Alternative II	At confluence mill site 15,530' @+12%	Same as Alternative IV
Mine Adit Access	New 1.41 mi. road @+6.5%, 20' wide with 75' ROW, graveled	FDR No. 2741 reconst 1.26 mi. to 24' wide gravel & unnamed spur, reconst 0.21 mi. to 20' wide graveled	All within mill site boundary except for short spur off of FDR No. 150 for large equipment	All within mill site boundary
Evaluation Adit Length & Grade	Up FDR No. 2741 6,592' @-10%	Same as Alternative II	Same as Alternative II	Same as Alternative II
Evaluation Adit Waste Rock	178,000 tons, Placed downhill of adit entrance	Same as Alternative II	Same as Alternative II	Same as Alternative II
Evaluation Adit Road, Length & Grade	Upgrade FDR No. 2741 for 4.6 mi. & reconst 0.18 mi. spur to 20' wide	Same as Alternative II	Same as Alternative II plus improve 2.8 miles of FDR No. 150 above confluence mill site	Same as Alternative IV
Evaluation Adit Water Discharge Line	6" polyethylene line approx 8.5 mi. both X-C & along Rd 150, laid on surface for 3 yrs	Same as Alternative II	Same as Alternative II	Same as Alternative II
New Road Construction	(1) 1.22 mi. new const beginning of FDR No. 150, 24' paved	(1) 2.3 mi. new const beginning of FDR No. 150, 24' paved (different location than Alternative II)	(1) Same as Alternative III	(1) Same as Alternative III but 1.62 miles
	(2) Const 1.07 mi. of 14' graveled road around mill	(2) Same as Alternative II except 24'	(2) N/A	(2) N/A
	(3) N/A	(3) Const 1,200' to connect FDR No. 150 to FDR No. 1022, gravel, 14' wide	(3) Same as Alternative III	(3) Same as Alternative III
	(4) Const 2.33 mi. of 14' graveled road from Sec. 15 to impoundment and const 1.02 of 10' graveled road in Sec. 3 & 10, both along slurry/reclaim lines	(4) Const 3,200' of 14' gravel road along slurry line, Sec 3 & 10	(4) N/A	(4) N/A
	(5) N/A	(5) 400' of 10' road for slurry/reclaim line (Rd150-B to water reclaim pump)	(5) Const 0.04 mi. of 24' paved road into mill site	(5) Same as Alternative IV
	(6) Const 1.43 mi. of 14' road around S & W of tailings imp for access to dam base and seepage collection line	(6) Const 1.6 mi. of 14' road around S end of tailings imp for access to dam base & rail load-out (paved w/turnouts)	(6) Same as Alternative III	(6) Same as Alternative III
	(7) N/A	(7) Const 1,200' of 14' road to access rail load-out (paved)	(7) Same as Alternative III but paved	(7) Same as Alternative IV
	(8) N/A	(8) Const 3,000' of 10' road - gravel for seepage collection line	(8) N/A	(8) Const. 22 mi. - 14' of paved road to paste plant
	(9) Mine Adit Access 1.41 mi. graveled	(9) N/A	(9) N/A	(9) N/A
	TOTALS: 1.22 mi. paved and 7.26 mi. gravel roads	**TOTALS:** 4.2 mi. new paved and 2.6 mi. new gravel roads	**TOTALS:** 4.19 miles paved and 0.25 gravel roads	**TOTALS**: 3.74 miles paved and 0.25 gravel roads
Road Reconstruction	(1) FDR No. 150 to mill, widened to 24' & paved for 5.1 mi.	(1) Same as Alternative II, but 4.02 mi.	(1) Same as Alternative II except only to confluence mill site, 2.94 mi.	(1) Same as Alternative IV but 3.42 mi.
	(2) FDR No. 150B from FDR No. 150 to seepage collection system 0.96 mi. of 14' (gravel)	(2) Improve FDR No. 150-B for 1.7 mi. from Rock Creek crossing to tailings impoundment, widen to 14' slurry line on inside edge of road (paved w/turnouts)	(2) Same as Alternative III	(2) Same as Alternative III including paste plant access 0.76 mi. paved and 1.07 mi. graveled

TABLE S-2
ASARCO Rock Creek Project Alternative Comparison (Cont'd)

Project Facility or Feature	Alternative II ASARCO Proposal	Alternative III Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V Paste Backfill & Alternative Water Treatment
	(3) Discharge line road to river 0.75 mi. - 10' wide (dirt) (4) N/A (5) Exploration adit road 0.189 graveled **TOTALS: 5.1 mi. paved, 1.89 graveled**	(3) Same as Alternative II but graveled (4) Mine Adit Access, reconst 1.26 mi. of FDR No. 2741 to 24' gravel and spur for 0.21 mi. to 20' wide (5) Same as Alternative II **TOTALS: 5.72 mi. paved, 2.4 graveled**	(3) Same as Alternative II (4) N/A (5) Same as Alternative II **TOTALS: 4.64 mi. paved, 0.93 graveled**	(3) Same as Alternative IV (4) N/A (5) Same as Alternative II **TOTALS: 4.18 mi. paved, 1.25 graveled**
Slurry and Reclaim Lines	From mill along FDR No. 150 to approx. center Sec. 3, then X-C to impoundment 4.7 mi. (two 10" high pressure urethane-lined steel slurry lines on piers, 1 buried 12' steel reclaim line) 3.3 mi. would be X-C, 1.4 mi. along FDR No. 150	Same as Alternative II to SE of Sec. 15 then continues on FDR No. 150 to SE of Sec. 22 where it follows FDR No. 150-B to impoundment 0.3 mi. X-C in Sec. 10 & 4.9 mi. parallels FDR No. 150	From mill along FDR No. 150 to intersection of old and new FDR No. 150, parallels FDR No.150B to tailings impoundment 3.8 mi. two 12" low pressure polyethylene, (buried)	Same route as Alternative IV but 4 mi. One 16-24" urethaned-lined steel pipeline for slurry, 16" reclaim water pipeline.
Excess Mine Adit Water Handling	(1) 12" polyethylene line buried adjacent to road from adit to mill, 6,700' (2) From mill 12" buried line parallels slurry line to Sec. 15, then parallel's FDR No. 150 to MT Hwy 200, then would parallel hwy for 500', would cross and parallel road to Clark Fork for 6.1 mi.	(1) Buried from adit down ridge 3,000' to mill (2) 12" steel excess water line parallels slurry line to intersection of new FDR No. 150, then parallels FDR No. 150 to waste water treatment plant, remainder same as Alternative II, 7.5 mi.	(1) N/A (2) Follows basically the same route as Alternative III except starts at confluence mill site, 6.1 mi.	(1) N/A (2) Basically the same as Alternative IV except 15-18" and goes X-C in Section 33 5.7 mi.
Transmission Line 230 kV Pole Line	Parallels existing 230 kV line from switchyard. Would cross hwy, then parallel newly constructed & reconstructed FDR No. 150 to mill, 5.7 mi.	Starts as in Alternative II, then parallels proposed FDR No. 150 & reconstructed FDR No. 150 to mill 6.6 mi. total length	Same as Alternative III except only goes to confluence mill site 5.2 mi.	Same as Alternative III except near waste water treatment site 5.3 mi.
Conveyor Line	From adit to mill 2,500' by 42" wide	Same as Alternative II	All within mill site	Same as Alternative IV
Wilderness Ventilation Adit	On approx 57% slope, 1,600' NE of ridge @ elev of 5,760'	In the cliffs on approx. 150% slope, 400' NE of ridge @ elev of 6,700'	Same as Alternative III	Same as Alternative III
Rail Load-out Location	At Herford siding	Miller Gulch	Same as Alternative III	Same as Alternative III
Tailings Impoundment Starter Dam Borrow	735,000 cu. yards of borrow from within impoundment & 2 borrow sites (27.2 acres)	Same as Alternative II	735,000 cu. yards of borrow from within impoundment, waste rock from adit construction and borrow site 3 (27.2 acres)	Borrow from within impoundment and utilize waste rock from adit construction

TABLE S-2
ASARCO Rock Creek Project Alternative Comparison (Cont'd)

Project Facility or Feature	Alternative II ASARCO Proposal	Alternative III Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V Paste Backfill & Alternative Water Treatment
Soil Storage				
(1) Evaluation Adit	(1) North end; 1.2 ac; 8,757 cy	(1) Same as Alternative II	(1) Same as Alternative II	(1) Same as Alternative II
(2) Support Facilities	(2) Adjacent storage; 1.3 ac; 4,193 cy	(2) Same as Alternative II	(2) Same as Alternative II	(2) Same as Alternative II
(3) Tailings Impoundment and associated components	(3) Impoundment, borrow areas, pump station S-1 parallel to powerline; 11.3 ac; 248,086 cy S-2 northeast corner near borrow site B-2; 8.3 ac; 179,649 cy Roads (access, haul); adjacent storage; 5.4 ac; 9,290 cy Water control structures; adjacent storage; 9.2 ac; 17,141 cy	(3) Similar to Alternative II but stockpiles S-1 and S-2 expanded to handle additional volume: S-1 increases to 18.1 ac; 563,227 cy S-2 increases to 16.4 ac; 549,598 cy	(3) Same as Alternative II	(3) Same as Alternative III but 2.2 acres of soil stockpiles insufficient to hold entire required volume but soil would be salvaged incrementally and replaced concurrently.
(4) Transportation Corridor	(4) Stored adjacent to each component; total 29.3 ac; 56,371 cy	(4) Soil stored adjacent to each component only when salvage showed clear benefit to revegetation and would not result in excessive disturbance	(4) Same as Alternative III	(4) Same as Alternative III
(5) Water Treatment Facility	(5) Adjacent storage; 10.0 ac; 32,269 cy	(5) Same as Alternative II	(5) Same as Alternative II	(5) Same as Alternative III
(6) Mill Facilities	(6) S-3 south end; 2.5 ac; 42,271 cy S-4 north end; 3.4 ac; 56,910 cy	(6) Similar to Alternative II but stockpiles S-1 and S-2 expanded to handle additional volume: S-3 increases to 78,921 cy S-4 increases to 93,560 cy	(6) New location at confluences mill site: north-center; 4.1 ac; 151,665 cy	(6) Same as Alternative IV
(7) Mine	(7) N/A	(7) Similar to Alternative II but new waste rock dump location has salvageable soil; stored along toe/sides of 2 small waste rock dumps; 9,681 cy	(7) Included in mill facilities (6) above	(7) Same as Alternative IV
	Total cubic yards: 655,949	**Total cubic yards: 1,367,649**	**Total cubic yards: 1,313,554**	**Total cubic yards: 1,313,554**
Mine Adit Water Treatment	Clarification filtration with a passive biotreatment and ion exchange system	Same as Alternative II	Same as Alternative II	Clarification, filtration, nitrification anoxic biotreatment/reverse osmosis, aerated pond with settling system.
Evaluation Adit Water Treatment	Pressure filtration, oil skimmer, and a passive biotreatment and ion exchange system	Same as Alternative II	Same as Alternative II	Pressure filtration, oil skimmer, and a reverse osmosis with a pilot anoxic biotreatment system.

Notes: X-C means cross country; N/A means not applicable; ROW means right-of-way; cy means cubic yards.

FIGURE S-2

FIGURE S-3

Operational and postoperational monitoring would be increased. This alternative reduces or eliminates adverse impacts associated with all of the identified significant issues except socioeconomics.

Alternative IV includes the modifications and mitigations proposed for Alternative III as well as an alternate mill/mine adit site (see the draft EIS for alternative description). The relocation of the mill/mine adit site reduces the surface disturbance to 542 acres (see **Figure S-4**). The construction and mine development period would be increased to 3.25 years. This alternative further reduces or eliminates adverse impacts associated with all eight significant issues.

Alternative V includes most of the mitigation and modifications from Alternative III and those from Alternative IV relating to the relocation of the mill site (**Figure S-5**). Additional modifications include deposition of tailings as a paste rather than as a slurry, modification of the water treatment system to include semi-passive biotreatment and reverse osmosis system, enclosure of the rail loadout facility and use of covered railcars, and relocation of the evaluation adit support facilities site away from Rock Creek. This alternative reduces or eliminates adverse impacts associated with all eight significant issues.

ASARCO has suggested some operational changes at the Agencies' alternative mill site to improve milling efficiency. This included relocating the mine adits and portals to line up with the milling facilities and replacing the secondary crusher with a semi-autogenous (SAG) mill. These changes have been incorporated into Alternative V.

AFFECTED ENVIRONMENT

The project area is situated in the Kaniksu National Forest (in Montana, administered by the Kootenai Nation Forest (KNF)), 13 miles northeast of Noxon in northwestern Montana, at the base of the Cabinet Mountains and adjacent to the CMW. Most of the area is forested. Annual precipitation varies over the area, and is largely influenced by elevation and topography. Rock Creek and its east and west forks, and the Clark Fork River provide surface water drainage.

Public lands are managed by KNF under the multiple use policies of the KNF Forest Plan. Small areas of private land occur in the project area. Timber harvesting, recreation, and wildlife habitat are the predominant land uses. The affected environment is described in detail in the draft EIS.

CONSEQUENCES OF THE PROPOSED PROJECT AND ALTERNATIVES

All alternatives would result in impacts of varying magnitude, duration, and importance to resources with regards to the eight issues discussed under Identification of Issues. However, as proposed, alternatives II through IV for the Rock Creek Project could result in potentially significant or significant impacts to environmental resources specified in seven of the issues. Alternative V could result in significant or potentially significant impacts to resources under six issues. They are briefly summarized below:

FIGURE S-4

FIGURE S-5

Issue 1: Effects on quantity and quality of Montana and Idaho surface and ground water resources.

In Montana, effects are predicted to impact

- aquatic invertebrates from sediment and nutrient loads (alternatives II and III);
- surface water quality from spills and pipeline ruptures (all action alternatives); and
- wilderness lake water levels and aquatic life from remote possibility of subsidence (all action alternatives).
- No measurable impacts are predicted for surface or ground water resources in Idaho.

Issue 2: Effects on fish and wildlife and their habitats and current and proposed threatened and endangered species.

Effects are predicted to impact

- grizzly bear habitat due to lost and reduced effective habitat (all action alternatives);
- neotropical migrant birds and pileated woodpeckers due to direct and indirect loss of old growth habitat (alternatives II - IV);
- harlequin ducks due to disturbance, habitat alteration, and increased mortality risk (alternatives II - IV);
- sensitive aquatic species (bull and westslope cutthroat trout) due to increased sediment and increased interbreeding with non-native species (alternatives II and III); and

Issue 3: Stability of the tailings impoundment/paste facility.

Effects from impoundment failure are predicted to impact

- surface water quality and aquatic life in lower Rock Creek and Clark Fork River if failure occurred (all action alternatives).

Issue 4: Impacts to socioeconomics of surrounding communities.

Effects as predicted to

- create a boom-bust employment cycle (alternatives II and III)
- exceed classroom capacities and exceed school accreditation standards (all action alternatives)
- place increase use on some near capacity water and waste water treatment systems

- requires implementation of ASARCO's approved Hard Rock Impact Plan.

Issue 5: Effects on old growth ecosystems.

Effects are predicted to

- Directly impact 0 to 28 acres of old growth (all action alternatives).
- Change habitat effectiveness from existing condition. Effectiveness would be reduced by 19 to 94 acres (alternatives II through IV), or increased by 1 acre (Alternative V).

Issue 6: Effects on Waters of the U.S. and wetlands.

Effects are predicted to impact

- Up to 9.6 acres of Waters of the U.S. and wetlands and decrease functions and values until mitigation sites, up to 13.8 acres (depending on the alternative), were established (all action alternatives).

Issue 8: Effects on aesthetic quality, including noise, visual, and wilderness experiences.

Effects are predicted to impact

- residents at Hereford (Alternative II only), mountain goats, and travelers on FDR No. 150 due to increases in sound levels from mine activities and traffic respectively (all action alternatives);
- visual quality of Rock Creek and Clark Fork Valley and ability to comply with Forest Service standards due to size, shape, color, texture and contrast of mine facilities with surrounding landscapes and the amount of time needed for reclamation/revegetation to mitigate impacts (all action alternatives); and
- solitude of wilderness users near the ventilation adit due to high visibility and elevated noise levels (alternative II).

Table S-3 (located at the back of the summary) provides a summary comparison of the effects of all alternatives with regards to all eight significant issues identified earlier in this chapter. The following discussion provides a more detailed summary comparison of the potentially significant or significant impacts.

Changes in Water Resources

Waste water treatment would be required as long as water being discharged into the Clark Fork River from the impoundment/paste facility, adits, and underground mine did not meet MPDES effluent limits. The adits could be plugged at their upper end, allowing water entering the adits to drain but holding back water entering the mineralized zone. If the mine adits were not sealed, mine adit water would not be allowed to discharge into Rock Creek as it is unlikely that the adit waters could meet water quality standards relative to Rock Creek. Adit water would have to be perpetually piped, treated if necessary, and discharged to the Clark Fork River. If the adits were sealed after mine closure, mine water eventually would discharge into bedrock, and possibly out through springs whose location cannot be determined at this time. Water draining from the adits would drain into the mine waste at the mill site and into the alluvium beneath it and then possibly into Rock Creek.

Prediction of the precise hydrogeologic effects of mine development within a fractured bedrock aquifer is extremely difficult even when numerous monitoring wells are available and the subsurface geology is well known. Nevertheless, the typical impacts of such mining activities are well-understood and are described below.

Void spaces created by underground mining tend to interconnect previously isolated fractures and faults. Prior to mining, some of these structures would have been conduits for groundwater while others would not have been connected to sources of recharge and would therefore have been dry or would not have been paths of significant flow. Mining can drain fractures, possibly resulting in loss of flow at pre-existing springs, and can also re-direct water into previously dry fractures, resulting in the formation of new springs. The locations of underground fractures and their relationships to surface features such as springs is frequently impossible to determine prior to mine development. Therefore, effects on springs and seeps cannot be predicted precisely. However, it can reasonably be predicted that mining could reduce flows at some springs (mostly above the ore deposit) and will likely increase flows at other springs downgradient of the deposit.

Construction of the mill pad, roads, and waste rock dumps would temporarily increase the concentrations of sediment and nitrogen loads of Rock Creek for alternatives II and III. The concentration of total suspended solids probably would not increase more than 7 mg/L. The concentration of nitrogen cannot be estimated with certainty and would depend upon the amount of nitrogen contamination of the waste rock, climate, infiltration beneath the mill pad, starter dams, and waste rock piles, and amount of surface runoff circumventing containment barriers and diversion structures. Aquatic invertebrates could be significantly impacted from increased nitrates in the short term. Impacts to aquatic plant communities or algae would be potentially significant in the short term from increases in nitrogen. Alternative III mitigations would reduce sediment loads in Rock Creek lessening the impacts to aquatic life. For alternatives IV and V, suspended sediment produced from construction of the mill facility, and residual nitrogen from blasting would not affect the West Fork Rock Creek because the mill would be located farther downstream, there would be less road construction/ reconstruction, and there would be no waste rock dump. The 300-foot stream buffer around the confluence mill site would further reduce sediment impacts to lower reaches of Rock Creek under alternatives IV and V. A sediment abatement effort on 114 acres of Rock Creek and/or Bull River watersheds in Alternative V would offset expected short-term sediment effects.

Impacts to aquatics and fisheries from spills and/or pipeline ruptures would be potentially significant for all action alternatives. The potential for spills to reach surface waters would be somewhat reduced due to consolidation of utility and road corridors and the relocation of the lower portion of FDR No. 150 away from Rock Creek. The potential for spills and rupture would be further reduced by burial of the pipelines under Alternative V. Relocating the mill to the confluence of the East and West forks of Rock Creek under Alternative IV and V would eliminate the potential for materials from spills and pipeline ruptures to reach the West Fork Rock Creek.

Changes in ground water quality for all four action alternatives would, for the most part, be restricted to an approved ground water mixing zone that must be approved by DEQ. Under all action alternatives, only nitrates and dissolved manganese would exceed Montana's standards (manganese exceeds the standard in ambient ground water) within the mixing zone. Clays removed for dam stability purposes in alternatives III and IV would be used to seal higher permeable areas such as the colluvium at the north end of the impoundment. An engineered perimeter drain and ground water extraction well system would collect and pump seepage back to the tailings impoundment and prevent changes in ground water quality outside of the mixing zone for alternatives II through IV. Discharge of tailings impoundment seepage to Rock Creek, Miller Gulch, and the Clark Fork River would be nearly eliminated. Frequent monitoring from associated compliance wells would be required to determine the effectiveness of the system and whether or not additional pump-back wells would be needed for alternatives II through IV or whether a pump-back system needs to be added for Alternative V.

ASARCO's water monitoring plan would be expanded for alternatives III through V and would include a Monitoring Alert Levels and Contingency/Corrective Action Plan. This plan would ensure early detection of potential environmental degradation or impairment and would focus primarily on the protection of surface and ground water resources. The intent of this additional plan would be to prevent pollution and other problems before they occurred. The water monitoring plan would be coordinated with the fishery/aquatics monitoring plan and wetlands mitigation and monitoring plans.

Wilderness Lakes and Wetlands. ASARCO would leave a minimum of 100 feet of overburden between mine workings and the ground surface. In the vicinity of Copper and Cliff lakes, in excess of 900 feet of overburden exists. Given this thickness of overburden and the inherent strength of the rock, the potential for fracturing and subsidence are extremely remote. Regardless, rock mechanics data from the evaluation adit and mined areas would be required for alternatives III through V. These data would be used for the Agencies' evaluation and approval of updated mine plans prior to mining near the lakes. Impacts to wilderness lakes, wetlands, and associated aquatic life from subsidence would be potentially significant for all action alternatives although the potential for subsidence would be extremely remote.

A contingency plan would be developed to mitigate impacts to the lakes and any associated wetlands to comply with the 404(b)(1) permitting process.

Changes to Wildlife, Habitat, and Threatened and Endangered Species

Grizzly Bears. The proposed project would physically alter habitat due to the construction of mine facilities (585 acres under Alternative II, 609 under Alternative III, 542 under Alternative IV, and 483 under Alternative V). Additional habitat effectiveness would be significantly reduced due to increased human activity. The reduced habitat effectiveness would be greatest during the construction phase; Alternative II would impact the greatest area (8,196 acres) and Alternative V would impact the least area (7,044 acres).

Reduced habitat effectiveness would be less during mine operation; Alternative II would impact 7,308 and Alternative V would impact 6,428 acres.

The existing Forest Plan standards for grizzly bear management on the KNF have been designed to provide the necessary components for a recovered grizzly bear population across the Cabinet-Yaak ecosystem (a minimum mortality risk, adequate food supply, spatial distribution of habitat and grizzly bears). The existing bear management standards are not being met in Rock Creek and the adjacent area and thus the area is not meeting the requirements for recovery of grizzly bear. The proposed project would result in a further decrease in the grizzly bear standards for Rock Creek and the surrounding area.

The recent bear management approach has been to restrict vehicle use on 6.9 miles of road in the Rock Creek drainage. An additional 4.81 miles (Alternative II) or 3.67 miles (alternatives III through V) would need to be closed to meet the 0.75 miles of open road per square mile standard for bear analysis areas. These additional road closures, stemming from the proposed project impacts, would not eliminate the impacts nor reduce the significance of the impact on bear recovery. The project would narrow the north-south movement corridor along the Cabinet Mountains resulting in a fragmented recovery area. The result is a potential delay in the recovery of the grizzly bear in the Cabinet-Yaak ecosystem due to the proposed project. The significance of the impacts is based not only on the need to minimize effects but on the mandate of the Endangered Species Act to "conserve and recover" the species. Mitigation would be phased in over the start-up period and be in place by the start of full operations. Mitigation may not prevent incidental taking; therefore, the action alternative may adversely affect the grizzly bear.

Other Threatened and Endangered Species. The increased risk of road-killed deer would increase the potential for vehicle collisions with feeding bald eagles along Montana Highway 200 and the railroad. The potential to lose a member of the existing bald eagle pair using the lower Clark Fork Valley would delay and thus significantly affect recovery of the species in this area. Mitigations for alternatives III through V include removal of road-killed deer from road rights-of-way. This, in conjunction with busing employees and eliminating the trucking of concentrates, would significantly reduce potential impacts to bald eagles.

Neotropical Migrant Birds. The loss of older forests (including old growth habitat) and riparian habitats (alternatives II through IV) would affect neotropical migrant birds (birds that seasonally migrate from tropical areas such as Mexico to North America). Habitat would be converted primarily to open grass communities, disturbed sites (such as borrow areas and tailings impoundment), or artificial areas (such as roads and buildings). Reclamation plans for alternatives III through V would create a more diverse vegetative habitat that would better replace lost or disturbed habitat than under Alternative II.

Sensitive Animal Species. All action alternatives could have significant to less than significant impacts on some sensitive species in the short or long term. Alternative I would have the least impact; although the development of ASARCO lands along Rock Creek if the company sold its lands, could have significant impacts on the harlequin duck. The action alternatives would generally decrease in impact from Alternative II through Alternative V. Indirect effects from increased human development in the surrounding Lower Clark Fork and Bull River valleys would be the most significant, unavoidable impact to most species considered.

The most significant impact would be to harlequin ducks in Alternatives II, III, and IV, where the alternatives were determined to trend the species towards federal listing under the Endangered Species Act. Alternative V incorporates adequate mitigation to prevent or avoid impacts such that this trend would not be expected to occur. The impacts to harlequin ducks would be from disturbance from mine-related activities,

habitat loss or alteration, water quality impacts, and the risk of a hazardous material spill. Indirect impacts as noted above would also affect harlequins, particularly along the other streams of the Lower Clark Fork subpopulation.

While fisher habitat would be reduced, fisher habitat is widespread on the Kootenai National Forest. Lack of available suitable habitat does not appear to be limiting to fishers. The habitat loss and increase in mortality risk decreases in impact from Alternative II to Alternative V. The most important key habitat, old growth, is not measurably affected in Alternative V. Mitigation features incorporated into Alternative V would reduce impacts to less than significant. All action alternatives were determined to potentially impact individuals but not trend the species towards federal listing under the Endangered Species Act.

Lynx habitat would not be significantly affected in any alternative, and none of the alternatives were expected to have a measurable impact on lynx. Mortality risk due to increased trapping pressure may occur; this is under management control should impacts be considered unacceptable in the future. Indirect effects of increased human development attributable to the project may decrease the ability of the low elevation Noxon area to be used as a long distance dispersal corridor. However, the corridor is currently significantly compromised from existing human developments and the incremental decrease in effectiveness of the corridor attributable to the project's effects are probably negligible.

Wolverine habitat would not be significantly affected in any alternative. Because wolverine are wide-ranging animals, the indirect impacts of increased disturbance and increased human development may increase mortality with all action alternatives. Mitigation proposed for grizzly bear would likely be effective in reducing the impacts of disturbance and increased mortality risk, and alternatives with mitigation proposed for grizzly bear would be the least impactive action alternatives. The effects of all the action alternatives were determined to possibly impact individual animals but not trend the species towards federal listing under the Endangered Species Act.

The increased traffic levels along FDR No. 150 may very slightly increase traffic-related mortality risk to Coeur d'Alene salamander. This level of mortality risk is unlikely to reduce viability for this species because the likelihood of occurrence is considered extremely remote. The action alternatives were determined to possibly impact individuals but not trend the species towards federal listing. Of the action alternatives, Alternative V has the least risk because of decreased mine-related traffic.

None of the other sensitive species analyzed were determined to be measurably impacted by the project.

Sensitive Aquatic Species. All action alternatives would impact resident populations of bull trout and westslope cutthroat trout in Rock Creek. These impacts would be the result of increased sediment loads from road construction and runoff. Rock Creek already has a high level of fine sediment, close to critical levels, in available spawning gravel. Increased sedimentation would significantly reduce fry emergence and potentially would lead to elimination of these fish populations due to spawning failure. Since Rock Creek and Bull River are the two major spawning areas for the Cabinet Gorge bull trout populations, degradation of the Rock Creek bull trout spawning habitat would significantly impact Cabinet Gorge bull trout.

Alternatives II and III would impact spawning habitat and resident fish populations the entire length of Rock Creek from the upper mill site to the Clark Fork River. These two action alternatives could have the greatest potential impact to the Cabinet Gorge bull trout populations. However, under alternatives III through V, the identification and reduction of existing sediment sources in the Rock Creek and the Bull River

drainages by ASARCO prior to mine construction would help offset short-term increases in sediment due to facility construction. The possible reduction of sediment sources in spawning streams in the Bull River drainage could improve bull trout populations and viability in those streams. These mitigations could reduce project-related impacts to the Cabinet Gorge Reservoir bull trout population. Other mitigations, such as construction-BMP monitoring also would help reduce sediment impacts to sensitive aquatic species under alternatives III through V.

Moving the mill site to the Rock Creek confluence (alternatives IV and V) eliminates project-related impacts to populations of bull and westslope cutthroat trout in the West Fork Rock Creek as well as reducing sediment impacts to spawning habitat and fish populations in Rock Creek below the confluence with its East Fork. Impacts to the Cabinet Gorge bull trout populations would be further reduced. Sediment mitigation on 114 acres of Rock Creek and/or Bull River watersheds would benefit all sensitive fish in the long term.

Under Alternatives II, III, and IV, catastrophic failure of the tailings impoundment could result in an irretrievable loss of sensitive aquatic species, particularly resident fish species. The risk of catastrophic failure would be greatly reduced by using paste technology.

Pileated woodpecker. Alternatives II, III and IV would have a potentially significant effect on local populations of the pileated woodpecker. This impact would be caused by direct habitat loss or reduced habitat effectiveness on 122 to 30 acres (alternatives II to IV, respectively). The anticipated small stand size, lower habitat quality, and limited quantity of habitat would affect sustainability of local populations. Alternative V would not measurably affect pileated woodpecker habitat.

Impoundment/Paste Facility Stability

Failure of the impoundment under alternatives II through IV, while a remote possibility, would have a significant impact to surface waters and aquatics/fisheries.

Alternative V incorporates paste technology as the tailings management option. The paste has less tendency to flow when it is not contained, and hence a failure of a paste slope would not result in the kind of tailings run-out which could be expected from a “wet” impoundment. While the likelihood of failure of a paste impoundment is considered negligible (less than 1 in 1 million chances of occurring), there would be an impact to surface waters and aquatics/fisheries should the paste reach a water source.

Changes in Socioeconomics

Employment. The development of this project would result in a significant boom-bust employment cycle with a peak employment of 433 construction and 355 mine operation workers for alternatives II and III. The additional construction time required for alternatives IV and V (3 years compared to 1.5 for alternatives II and III) would reduce the peak construction work force to 350 workers but impacts would still be moderate to major. About 140 to 150 indirect jobs would be generated for alternatives II through V. Approximately 50 percent of the construction workers and 80 percent of the mine operation workers would be hired locally.

Housing. Housing, especially rental units, is already limited in the project vicinity. Demand for rentals during mine construction would be expected to create a housing shortage. A moderate-sized mobile home court or an apartment building would be expected to be developed to meet these needs. New home construction probably would increase once the mine began operating and long-term residences would be

needed for mine workers. Increased housing costs may impact people on fixed or low incomes. After mining operations ceased, there might be a surplus of houses in the area.

Community Services. ASARCO's Hard Rock Impact Plan[2] has been developed and identifies how financial mitigations for impacts to local government services would be implemented. The plan would provide relief needed to mitigate the fiscal impacts to direct local government services identified for any action alternative.

The increase of students (total of 63 elementary and 29 high school students) during mine construction may exceed classroom capacities and school accreditation standards in Sanders County (41 elementary and 19 high school students). Since this temporary increase would end after approximately 1.5 to 2 years, local schools may decide to maintain current educational quality by hiring additional teachers rather than increasing class sizes. A total of 63 new students (44 in Sanders County) would be enrolled during mine operation.

Community water facilities in Noxon and Heron are near capacity. Impacts to ground water resources for private wells cannot be determined at this time. Thompson Falls sewage treatment facility is near capacity and would not be able to accommodate additional demands.

Changes in Old Growth Ecosystems

Effective Old Growth Habitat. Alternatives II through IV would destroy old growth or render it less effective. Alternative II would affect a total of 122 acres; Alternative III, 47 acres; and Alternative IV, 30 acres. Because of closure of some open roads, Alternative V would result in a slight increase in habitat effectiveness by one acre. Mining-related disturbances would fragment stands below 25 acres and create more edge effect in larger stands. The percent of biologically effective habitat would be below the 8 to 10 percent needed to support old growth dependent species under alternatives II through IV. Pileated woodpeckers, goshawks, and fishers are among old growth associated species that would be affected by this loss. A potentially significant decline in species diversity could result under the action alternatives that reduce old growth.

Changes in Waters of the U.S. and Wetlands

All four action alternatives would fill Waters of the U.S. and wetlands. The tailings impoundment footprint would directly and indirectly impact the same total amount of wetlands for all action alternatives. The Alternative V construction of the paste tailings impoundment panels phased-in throughout the 34-year project would delay the direct and indirect impacts to the wetlands, particularly those located directly under the impoundment. The location of the mill site and waste rock dump and the alignment of FDR No. 150 determines the total amount of wetlands and Waters of the U.S. impacted by each alternative. Alternative II would impact a total of 8.1 acres of wetlands and 1.5 acres of Waters of the U.S. Alternative III would impact a total of 6.2 acres of wetland and 1.5 acres of Waters of the U.S.; and Alternative IV would impact a total of 6.2 acres of wetland and 0.4 acres of Waters of the U.S. Alternative V would also impact a total of 6.2 acres of wetlands and 0.4 acres of Waters of the U.S. These would be significant impacts.

[2] Submitted June 23, 1997, and approved October 23, 1997.

Temporary indirect impacts to Waters of the U.S. and wetlands would occur during construction of roads and the mill pad due to increased sediment contributions. Proposed BMPs would reduce sediment contributions. Alternatives II and III would have temporary impacts at specified locations along Rock Creek from the confluence of the East and West Forks to the Clark Fork River. Alternatives IV and V primarily would have indirect impacts below the confluence of the East Fork Rock Creek. Very few indirect impacts would be associated with the evaluation adit other than the reconstruction of FDR No. 2741. Alternative V would have nearly the same total acreage of indirect impacts as the other action alternatives, but the timing of the impacts would be delayed throughout the 34 year project with the past tailings construction.

ASARCO has identified 12.3 acres of wetland mitigation sites and 1.5 acres of Waters of the U.S. mitigation sites for Alternative II. Only 10.5 acres of the wetland mitigation sites would be available for alternatives III and IV due to the realignment of a segment of FDR No. 150. There are, however, potential sites within the floodplain along Rock Creek that could be identified and used for mitigation should the COE require additional mitigation areas. Alternative V would develop a total of 7.0 acres of wetland mitigation sites along Rock Creek and at the Miller Gulch site.

In addition, ASARCO has identified three optional wetland mitigation sites that could be developed if the proposed sites prove to be less successful than anticipated for replacing the lost wetland functions and values. All wetland mitigation sites would be developed as replacement wetlands prior to disturbance of the existing wetlands. The 1.1 acres of Waters of the U.S. at the upper mill site (alternatives II and III) would not be reconstructed until the mill site was reclaimed. The 0.4 acres of Waters of the U.S. along the FDR No. 150 and the utility corridor under all action alternatives would be temporarily impacted during construction. The primary functions and values of the created wetlands would be to re-establish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek, and attenuate peak flows. A temporary but potentially significant decrease in some of the wetland functions and values could occur until the created wetlands were revegetated and fully established.

Changes in Aesthetic Quality

Noise. All action alternatives could create significant long-term noise-related impacts to mountain goats and their key summer habitat (see above). These impacts would be associated predominantly with the evaluation adit and the wilderness ventilation adit. Sound mitigations at the ventilation adit would minimally reduce the impacts. Alternative IV and V may also affect critical winter range at Rock Creek Meadows should loud noises, such as blasting, reach the winter range.

Blasting during adit construction would generate noise up to 80 dBA in the CMW and the Clark Fork Valley. While general mine operations would not be audible in the Clark Fork Valley, the operation of heavy equipment at the impoundment site would be audible in adjacent areas. Activities at the Hereford rail loadout (Alternative II) would significantly increase noise levels to residences in the area. Relocation of the loadout to Miller Gulch would eliminate that impact and place the noise in a less populated area.

Recreationists using the Rock Creek drainage and FDR nos. 150 and 2741 would be able to hear mine and mill operations when within a mile of the facilities. Traffic related noise on FDR No. 150 would be increased significantly from 30 to 70 dBA. The level of the noise would be somewhat reduced in alternatives III and IV with the implementation of several noise mitigations and to an even greater extent under Alternative V.

Noise impacts to recreationists within the CMW would be associated primarily with the evaluation and wilderness ventilation adits and blasting and construction equipment noises (up to 80 dBA). Impacts

from evaluation activities would be greatest during the first couple of years of mine activities; after that, noise would only be generated by ventilation exhaust fans. Sound from all adits would be audible (at 45 dBA) for approximately 1 mile away from the sites. The wilderness ventilation adit would only be in place and used during the last 15 to 20 years of mining. These sounds would negatively impact CMW visitors using nearby areas. Sound mitigations in alternatives III through V would reduce the fan noise to background levels (30 dBA) within 100 feet.

Scenic Quality. All four action alternatives would result in significant visual impacts for the Rock Creek drainage and Clark Fork Valley. Impacts would be associated with all features of the proposed project: the evaluation adit, the mill site, the mine portal and associated waste rock dumps, the ventilation adit (see wilderness below), the utility corridors and the tailings impoundment/paste facility.

The evaluation adit portal would be most noticeable from Government Mountain, though the impacts would diminish with distance. Lights from night operations would be visible in portions of the Clark Fork Valley. These visual impacts would be reduced in alternatives III through V. The waste rock dump would be revegetated to reduce contrast. Lights would be screened or baffled to reduce visibility across the valley.

The upper mill site in alternatives II and III would be highly visible to the public using FDR nos. 150 and 2741 but not visible from the Clark Fork Valley. The conveyor from the mine portal would create a strong linear feature that would contrast greatly with the natural landscape. The cut-and-fill slopes of the new mine access road for Alternative II would be visible for a long time. Under Alternative III, the new mine access road would not be built, reducing the amount of disturbance and visibility. The buildings would be painted or treated to reduce the amount of contrast.

The waste rock dump for Alternative II would be a prominent feature that would be difficult to revegetate and would remain highly visible for many years. The dump would be divided into two smaller dumps in Alternative III and graded closer to the natural slopes than was proposed in Alternative II. The dumps would be topsoiled and revegetated to facilitate reduction of visual impacts.

Alternatives IV and V would move the mill site to the confluence with the East Fork Rock Creek. A minimum 100-foot visual buffer would be left on either side of FDR No. 150 to provide screening. There would be no waste rock dump for this alternative as the rock would be used to build the mill pad and the impoundment starter dams or toe buttresses for the paste facility. The face of the mill pad would be reclaimed immediately after construction. Visual impacts from the confluence mill site would be potentially significant.

Either design of the impoundment or the paste facility would result in a large artificial form visible from several areas in the Clark Fork Valley. The size, form, color and texture of the tailings disposal facility would contrast dramatically with the surrounding landscape. The long-lasting effects would gradually be reduced as trees and shrubs were established. Reclamation of the impoundment face would be done concurrently throughout mine life for Alternative II. Trees and shrubs, however, would be planted after the face of the impoundment was completely reclaimed for Alternative II. Alternatives III and IV would require additional detailed regrading and revegetation plans to facilitate the mitigation of visual impacts. Reclamation, including the planting of trees and shrubs for alternatives III and IV, would begin after year 7 and would be concurrent until operations ceased. Trees would also be planted along Montana Highway 200 for screening as soon as Agency permits were approved. Under Alternative V, final reclamation would begin on paste surfaces when final grade was achieved with timing dependent on construction sequencing.

The proposed Visual Management System (VMS) Visual Quality Objectives (VQO) would not be achieved during mine life for all action alternatives. The impoundment surface potentially could never meet Retention VQO standards under Alternative II, but additional reclamation requirements under alternatives III through V would increase the likelihood that the standard could be achieved within several decades after final reclamation. Under Alternative IV and V, the elimination of the waste rock dump, immediate planting of the mill pad face, and the visual buffer around the confluence mill site would further help this site meet VQO standards. Although the facility sites could eventually achieve prescribed VQOs several decades after mine closure and final reclamation, the additional reclamation requirements would shorten the amount of time required, but it would still take decades.

Wilderness. There would be two types of impacts to users of the CMW: noise-related and visual. The noise-related impacts would be greatest during the construction and operation of the evaluation adit, construction of the mine adits and mine pad and the construction and use of the wilderness ventilation adit (see Noise). Mitigations under alternatives III through V would reduce these potentially significant impacts. Visual contrast of the impoundment surface would remain for alternatives II through IV due to its light color until completion of mine revegetation following mine closure. The phased reclamation of the paste facility would reduce its visual impact under Alternative V. The area of disturbance for the ventilation adit would be reduced in alternatives III through V by its relocation to a steeper site. Either location, however, is not in proximity to high use areas such as Rock, Saint Paul, and Moran lakes. Reclamation mitigations proposed under alternatives III through V would restore a premining appearance to the ventilation adit.

THE AGENCIES' PREFERRED ALTERNATIVE

The Agencies' preferred alternative is Alternative V, modified Rock Creek Project with Mitigations. Alternative V would result in construction of the evaluation adit, mine, mill, tailings paste facility, rail loadout, reverse osmosis and passive biotreatment facility, and access roads. The Bottom-Up construction option would be used and final design would incorporate measures to meet visual impact mitigation and reclamation goals. Some water would be stored in underground workings and/or the tailings impoundment, but excess water would be discharged to the Clark Fork River after treatment. Environmental requirements in addition to those proposed by ASARCO would be incorporated to avoid and minimize (to the extent possible) or eliminate environmental impacts. Additional monitoring would help detect trends as well as unacceptable impacts, should they occur. Measures would be developed to respond to and control any unacceptable impacts that may be detected.

TABLE S-3
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Water Resources					
Surface water quality	Except for minor increases in sediment, existing surface water quality would be maintained.	Minor increases in metals, nitrogen, ammonia, and total dissolved solids concentrations in Clark Fork River from treated discharges during operations.	Same as Alternative II	Same as Alternative II	Same as Alternative II but with increased treatment reliability and minor increases in phosphorus due to changes in waste water treatment systems.
		Nitrogen loads would be temporarily increased in Rock Creek and the West Fork during mine construction and would impact aquatic invertebrates and algae in the short term.	**Same as Alternative II**	Similar to Alternative II but the aquatic life in West Fork of Rock Creek above the confluence mill site would not be affected by increased nitrogen from mine construction, or waste rock dumps. The 300' buffer zone around confluence mill site would reduce nitrogen loading to Rock Creek.	Same as Alternative IV.
	Sediment-loading for Rock Creek may temporarily increase due to construction of roads and land clearing for timber sales.	Sedimentation would be reduced because timber road construction for NFS lands in the Rock Creek drainage may be limited due to project increased open road densities.	Same as Alternative II. Sediment would also be reduced by relocating a portion of FDR No. 150 and the utility corridor and by identifying and reducing existing sediment sources.	Same as Alternative III.	Same as Alternative III but additional sediment reduction due to fewer roads, paste facility construction, modified reclamation plans, reduction in mine-related traffic, and sediment mitigation on 114 acres.
		Impacts from materials from spills and pipeline ruptures potentially could affect water quality in Rock Creek and the Clark Fork River.	**Same as Alternative II except the potential for material from spills and pipeline ruptures to reach the main stem of Rock Creek is reduced.**	**Same as Alternative II except potential for spills and pipeline ruptures in West Fork of Rock Creek would be eliminated.**	Potential for pipeline ruptures would be reduced because tailing, process water, and ore concentrate pipelines would be double-walled with leak detection. Impacts from spills of ore concentrate would be minimized by piping to an enclosed rail loadout facility.
Ground water quality	Ground water quality would be similar to existing quality.	Ground water quality standards for nitrates and dissolved manganese would be exceeded within an approved mixing zone during construction and operation of tailings impoundment. Downgradient ground water quality would not be affected beyond the mixing zone as a result of a ground water extraction and pump-back system.	Similar to Alternative II, except impoundment seepage would be reduced by using excavated clays to seal permeable contact zones. The technical panel reviewers for impoundment design would investigate the use of seepage reduction techniques (which may include synthetic or clay liners) to further minimize seepage if acid-base accounting of waste rocks indicated potential for acid drainage.	Same as Alternative III.	Tailings paste seepage would be reduced by one order of magnitude to approximately 30 gpm.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Surface water quantity	Appropriated water would continue to be withdrawn from surface water.	Surface flow in Miller Gulch would be reduced during operations.	Same as Alternative II.	Same as Alternative II.	Similar to Alternative II.
Ground water quantity	Ground water well production from appropriated sources would be similar to existing production.	Possible decrease in static water levels in wells not in Clark Fork alluvium and spring flow downgradient of Miller Gulch during operation.	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
		Portal plugging and subsequent mine flood-ing may generate downgradient springs	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
Wilderness lakes and wetlands	Wilderness lakes would continue to experience natural and seasonal water level fluctuations.	**The potential for subsidence is remote. Impacts would be potentially significant.**	**The potential for subsidence, although remote, would be reduced by additional rock mechanics studies and a subsidence control plan. Impacts would be potentially significant.**	**Same as Alternative III.**	**Same as Alternative III.**
		Aquatic life and wetlands associated with Cliff and/or Copper lakes could be significantly impacted if subsidence occurred.	**Potentially significant, short-term impacts to wetlands and aquatic life associated with Cliff and/or Copper lakes would be mitigated in accordance with a mitigation plan if subsidence occurred.**	**Same as Alternative III.**	**Same as Alternative III.**
Wildlife, Habitat, and Threatened & Endangered (T&E) Species					
Grizzly bears	Continued availability of spring and fall grizzly bear habitat.	**Direct physical loss of 585 acres of habitat. Habitat effectiveness would be reduced on an estimated 7,308 acres during operation. This would have a potentially significant impact on grizzly bear habitat. Decrease in habitat effectiveness in all impacted BMU's.**	**Direct physical loss of 609 acres of habitat. Habitat effectiveness would be reduced on an estimated 7,001 acres during operation. This would have a potentially significant impact on grizzly bear habitat.**	**Direct physical loss of 542 acres of habitat. Habitat effectiveness would be reduced on an estimated 6,635 acres during operation. This would have a potentially significant impact on grizzly bear habitat.**	**Direct physical loss of 481 acres of habitat. Habitat effectiveness would be reduced on 6,428 acres during operation.**
	Slight increase in habitat effectiveness due to road closures.	The KNF would need to close 4.8 miles of roads to reduce open road densities to meet the 0.75 miles of open road per square mile standard for bear analysis areas.	Open and total road densities would be reduced. KNF would need to close 3.67 miles of roads to reduce open road densities to meet the standard.	Same as Alternative III.	Same as Alternative III.
		Increased mortality from road kills, poaching, and destruction of nuisance bears.	Similar impacts as Alternative II but somewhat reduced due to additional mitigations.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Other T&E species	Bald eagle use would continue to increase.	**Increases in road-killed deer could slightly and indirectly increase mortality risk of bald eagles along MT Hwy. 200, FDR No. 150, and along the train tracks near the Hereford siding. The increased potential to lose a member of the existing pair of eagles could significantly affect recovery of the species in the area.**	Increases in road-killed deer and associated bald eagle mortality risk along MT Hwy. 200 is less than Alternative II because of rerouting concentrate haulers to the Miller Gulch rail load-out along FDR No. 150B and daily removal of road-killed animals.	Same as Alternative III.	Same as Alternative III.
	Migratory peregrine would continue to use the Clark Fork River drainage.	Similar to Alternative I.	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
Big game animals	Minor changes in habitat or activities of big game animals; security could be improved as open road densities were reduced. Displacement and possible increased mortality of animals due to increased human development in Rock Creek if ASARCO releases its Rock Creek lands.	Increased potential for animal-vehicle collisions.	Similar to Alternative II.	Similar to Alternative II.	Lowest of action alternatives because of proposal to bus employees.
		Minor loss of habitat for game species including travel corridors, riparian areas and a few small bull elk wintering areas.	Similar to Alternative II.	Habitat loss associated with the mill in the upper West Fork of Rock Creek would be shifted to the confluence mill site.	Habitat loss is the least of the action alternatives.
		Displacement and possible increased mortality of animals due to increased human use and activities (including hunting and poaching).	Somewhat less impact because of road closures.	Similar to Alternative III.	Same as Alternative III.
Neotropical migrant birds	Minor changes in forested habitat or activities of neotropical migrant birds unless ASARCO releases its Rock Creek lands for development, Increased homesites could decrease bird diversity by introduction of pest species and direct habitat loss.	**Direct and indirect loss of old growth, riparian, and wetland habitats would affect songbirds in those areas. Potential loss of individual birds.**	**Same as Alternative II.**	**Same as Alternative II.**	Substantially similar to Alternative I for old growth and same as Alternative II for riparian and wetland habitat.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Sensitive animal species	Stability of harlequin duck population in lower Clark Fork would remain vulnerable.	**Human disturbance and habitat alteration could result in loss of harlequin duck reproduction on Rock Creek. Loss of Rock Creek breeding area would increase vulnerability of the lower Clark Fork harlequin subpopulation.**	**Impacts to harlequin duck habitat lessened with relocation of FDR No. 150 out of the riparian area but remain potentially significant and similar to Alternative II.**	**Similar to Alternative III.**	Impacts to harlequin ducks less than Alternative IV because of busing mine employees, slurrying concentrates and seasonal closing FDR No. 150B: operating limitations, and moving of the evaluation adit support facilities site.
	Habitat for lynx, fishers, and wolverines would continue to be reduced as frag-mentation and habitat degradation continued. Disturbance and mortality risk would continue to increase slowly as regional human population increased.	Fisher and wolverine habitat quality reduction (especially old growth, riparian areas and travel corridors) and disturbance could displace animals.	Similar to Alternative II.	Moving the mill site and impacting less old growth would reduce the impact below Alternative III.	Change in effectiveness of old growth would be essentially unmeasurable. Mortality risk further controlled through mitigation measures.
	Disposition of lands in Rock Creek by ASARCO could increase human development in drainage with resulting impacts to harlequin ducks, fisher and resident birds.	Potential increases in hunting, trapping, poaching, and traffic collision mortality would add to the overall decline of fisher and wolverine security in the Cabinet Mountains, and the region.	Similar to Alternative II.	Similar to Alternative II.	Busing mine employees decreases risk of mortality from vehicle collisions and vehicle disturbance.
Sensitive aquatic species	**Sediment impacts from private and KNF timber sales and other developments could have a significant impact on aquatic resources.**	**Increased sediment in West Fork and mainstem Rock Creek would significantly decrease emergence success of bull and cutthroat trout fry.**	**Modifications and mitigations would reduce the amount of sediment impacting Rock Creek spawning habitat and bull and cutthroat trout.**	Sediment impacts to bull and westslope cutthroat trout would be minimized in the West Fork of Rock Creek. The 300 ft. buffer around the confluence mill site would reduce sedimentation impacts downstream.	Similar to Alternative IV, but lesser amount of disturbed acreage and relocation of evaluation support facily should further reduce sediment impacts.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Sensitive aquatic species (Continued)	Natural changes in aquatic habitat are expected, marginal threat to long-term survival for Cabinet Gorge bull trout stock and long-term risk of loss of cutthroat population due to introgression.	**Reduced bull trout habitat in Rock Creek could significantly impact Cabinet Gorge bull trout.**	**Reduction of existing sediment sources in Rock Creek and Bull River drainages would improve the status of bull trout and cutthroat populations in Rock Creek, and bull trout in Cabinet Gorge Reservoir.**	Similar to Alternative III but 300-ft. buffer around the confluence mill site would further reduce sediment impacts to bull and cutthroat trout in mainstem Rock Creek and bull trout in Cabinet Gorge Reservoir.	Similar to Alternative IV, but negotiation with private land ownders to reduce sediment sources should further reduce sediment impacts.
		Potential increase in non-native fish species and interbreeding with native sensitive species (westslope cutthroat trout and bull trout).	Risk of interbreeding and non-native fish species increase would be reduced due to sediment mitigations.	Similar to Alternative III.	Similar to Alternative III.
		Catastrophic failure of the tailings impoundment could result in an irretrievable loss of sensitive aquatic species, particularly resident fish species.	Similar to Alternative II	Similar to Alternative II	Risk of catastrophic failure of tailings paste facility greatly reduced by using paste technology.
Plant species of special concern	Sixteen populations of 5 different plant species of special concern within the permit area would remain undisturbed. Crested Shield fern was not found in study area.	Nine populations of 4 species of special concern would be eliminated.	Eleven populations of 4 species of special concern would be eliminated if they cannot be avoided during construction.	Same as Alternative III	Same as Alternative III.
Mountain goats	Some of the Rock Peak goat herd could be affected by the Montanore mine which could result in stress or displacement of some goats. If goats are displaced, an increase of goats in vicinity of Rock Creek in summer/transitional ranges could result.	Project-related noise and disturbance would change habitat effectiveness to 85-91% in key summer habitat.	Project-related noise, disturbance, and facility location would change habitat effectiveness to 86-93% in key summer habitat.	Project-related noise, disturbance, and facility location would change habitat effectiveness to 87-92% in key summer habitat.	Similar to Alternative IV.
	Habitat effectiveness is 91% in key summer habitat.	The cumulative effects of the Montanore and Rock Creek projects could result in a decline in numbers.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		Increased mortality risk would occur due to increased human use of the area by recreationists, hunters, and poachers.	Similar to Alternative II, but additional road closures would reduce mortality risk.	Similar to Alternative III.	Similar to Alternative III, but mitigation includes increased law enforcement and monitoring to control mortality risk.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Pileated woodpecker	Habitat availability to sustain local populations of pileated woodpeckers would remain below recommended biologically sound levels. Effective old growth currently is 867 acres.	**Effective old growth would reduce 16% to 745 acres, which potentially significantly affect sustainability of local pileated woodpecker populations.**	**Effective old growth would reduce 5% to 820 acres, which would potentially significantly affect sustainability of local pileated woodpecker populations.**	**Effective old growth would reduce 3% to 837 acres, which would potentially significantly affect sustainability of local pileated woodpecker populations.**	Effective old growth would remain substantially the same, resulting in similar effects as Alternative I.
Impoundment/Paste Facility Stability	No tailings impoundment would be constructed, therefore no risk of failure.	Risk of impoundment failure would be possible but remote. **Impacts from an impoundment failure to surface waters and aquatics would be potentially significant.**	Modified design and construction details as well as a technical panel review of the design would further reduce the risk of impoundment failure. **Same as Alternative II.**	Same as Alternative III. **Same as Alternative II.**	Modified design and use of paste tailings along with a technical panel review of the design further reduce the risk of paste facility failure. **Same as Alternative II.**
Socioeconomics					
Employment	Employment growth would come from service sector jobs.	The project would directly generate up to 433 construction and 355 mine operation related jobs and about 140 indirect jobs. Growth of service sector jobs would be hindered by resource extraction dependent employment.	Same as Alternative II.	Similar to Alternative II but Alternative IV would directly generate up to 350 construction workers, 355 mine operation workers and about 150 indirect jobs.	Same as Alternative IV.
	Employment would continue at existing trends.	The project would generate an employment boom-bust cycle between mine construction and operation phases.	Same as Alternative II.	Mine construction employment scheduling could reduce peak construction to levels closer to mine operation employment and would moderate the boom-bust cycle.	Same as Alternative IV.
Population	Substantial population increase at predicted rate.	Project employment and associated immigration would result in a population increase of approximately 4% in Sanders County, and less than 0.4% in Bonner and Lincoln counties during construction. Mining operations would result in an increase of less than 3% in Sanders County and less than 0.15% in Bonner and Lincoln counties. Population increases in Sanders County could be potentially significant. Would decrease long-term population growth by up to 500 persons.	Similar to Alternative II.	Both mine construction and operations and the associated immigration would result in an increase of less than 3% in Sanders County and less than 0.15% in Bonner and Lincoln counties.	Same as Alternative IV.
Income	Moderately increasing personal income.	The generation of an annual personal income of $9.6 million and indirect income of $1.5 million would increase three-county personal income by 2 percent.	Similar to Alternative II.	Similar to Alternative II.	Same as Alternative IV.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Housing	Existing housing shortages would continue.	Increased housing shortage during mine construction could result in construction of mobile-home court or apartment building. New homes would be built during mine operations resulting in a potential surplus after mine closure.	Similar to Alternative II.	Similar to Alternative II.	Same as Alternative IV.
Community Services	Moderate increases in demand for already burdened community services.	Increased need for law enforcement and fire protection personnel.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		Classroom capacities and school accreditation standards may be exceeded in some communities during construction.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		Some community water and/or wastewater treatment facilities may be unable to absorb additional users.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		ASARCO's Hard Rock Impact Plan would help mitigate financial costs associated with resolving project impacts.	Same as Alternative II.	Same as Alternative II.	Similar to Alternative II.
Fiscal	Revenues and government expenses would continue along existing trends.	Increased needs for services would impact Sanders County's ability to finance those services.	Same as Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		Increased property and income tax revenues.	Same as Alternative II.	Similar to Alternative II.	Similar to Alternative II.
Land use	Land use patterns and changes would continue at existing rates and locations.	About 400 acres at impoundment site would be unusable for most existing land uses.	Same as Alternative II	Same as Alternative II.	Similar to Alternative II.
		Approximately 3,074 acres of private lands needed for grizzly bear mitigation would be removed from residential and commercial land uses.	Approximately 2,692 acres of private lands needed for grizzly bear mitigation would be removed from residential and commercial land uses.	Similar to Alternative III except that only 2,536 acres of private lands would be removed from future development.	Similar to Alternative III except that only 2,350 acres of private lands would be removed from future development.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Old Growth Ecosystems (excludes replacement old growth)	Approximately 6.2% of Compartment 711 would remain in effective old growth habitat. This percentage would change over time due to natural succession and natural occurrences, (e.g., fire).	**About 122 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 5.3% of Compartment 711.**	**About 47 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 5.9% of Compartment 711.**	**About 30 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 6.0% of Compartment 711.**	Essentially the same as Alternative I.
	Effective old growth habitat would remain below the recommended levels to provide for long-term maintenance of old growth dependent species in Compartment 711.	**Biological diversity would be reduced and long-term occurrence of old growth dependent species would be unlikely.**	**Similar to Alternative II, except the likelihood of long-term maintenance of old growth dependent species is improved over Alternative II.**	**Similar to Alternative II, except the likelihood of long-term maintenance of old growth dependent species is improved over Alternative III.**	Essentially the same as Alternative I.
Waters of the U.S. & Wetlands					
Wetlands & riparian zones	Wetland and riparian zones could be disturbed by timber sale roads and development of private lands.	**A total of 9.6 acres of Waters of the U.S. and wetlands would be disturbed by the project.**	**About 7.7 acres of Waters of the U.S. and wetlands would be affected.**	**Less than 6.6 acres of Waters of the U.S. and wetlands would be disturbed.**	**Similar to Alternative IV**.
		Functions and values may decrease until the 13.8 acres of Waters of the U.S. and wetland mitigation sites were established.	**Similar to Alternative II but only 10.5 acres of Waters of the U.S. and wetland mitigation sites have been identified.**	**Same as Alternative III.**	**Similar to Alternative II but only 7.0 acres of wetlands mitigation sites are proposed.**
Transportation					
Public access	Public access for hunting, fishing, hiking and other recreational activities would remain the same.	There may be delays and temporary road closures during road construction and reconstruction.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		N/A	FDR No. 150B between Engle Creek and Government Mountain Road west would be restricted to mine-related traffic.	Same as Alternative III.	FDR No. 150B would be closed during operation between Engle Creek and paste plant.
		Paving of FDR No. 150 and widening of FDR No. 2741 would improve year-round public access to the CMW and for general recreational activities.	Same as Alternative II.	Public access from FDR nos. 2741 and 150 above the confluence of the East and West forks of Rock Creek would remain the same as Alternative I.	Same as Alternative I.
Public access (Cont)		Close 4.81 miles of road (1.88 mi. of FDR No. 2741-Chicago Peak Rd., 0.18 mi. of FDR No. 2741x and 2.75 mi. of FDR No. 2285-Orr Gulch Rd.)	Same as Alternative II but 3.67 miles - would close 1.61 miles of Orr Gulch Rd.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Traffic safety	Traffic volumes and accident risk would grow or decline with population changes, timber sales, and development of private lands.	The average daily traffic (ADT) for Montana Hwy. 200 would increase by 71 percent during construction and by 38 percent during mine operation. The ADT for FDR No. 150 also would increase by 2,800 percent and 1,440 percent, respectively. This would increase the chances for traffic-related accidents on these roads.	ADT would remain essentially the same as in Alternative II. Any carpooling and busing would reduce ADT.	Similar to Alternative III, except that ADT on FDR nos. 150 and 2741 above the confluence of the East and West forks of Rock Creek after evaluation was completed would be similar to Alternative I.	ADT on Hwy 200 would be the same as Alternative II with busing of mine employees. The ADT on FDR No. 150 would increase 1,100 percent over Alternative I during construction and 200 percent during mine operation. Above the mill site, the traffic would be similar to Alternative I.
	Traffic to Hereford rail siding and Government Mountain (FDR No. 150) would remain at existing levels.	Slow moving ore concentrate trucks travelling to and from the Hereford rail load-out would be turning onto and off the Montana Hwy. 200. This would create additional hazards to higher speed highway traffic and residential traffic at Hereford.	Ore concentrate truck traffic would be eliminated from Montana Hwy. 200. ADT on FDR No. 150B from Engle Creek to the Miller Gulch rail load-out would show a slight increase.	Same as Alternative III.	Ore concentrate would be slurried from mill to rail loadout thus eliminating the need for concentrate trucks.
		Road alignment of FDR No. 150 and MT Hwy. 200 intersection could increase potential for accidents.	FDR No. 150 and Montana Hwy. 200 intersection location complies with state standards and would not increase potential for accidents.	Same as Alternative III.	Same as Alternative III.
Aesthetic Quality					
Noise	Existing noise levels in the Rock Creek drainage and Clark Fork Valley would be maintained except for changes associated with timber sales and private land development.	Long term noise-related impacts to mountain goats (see above).	Long-term impacts to mountain goats would be somewhat reduced (see above).	Similar to Alternative III.	Same as Alternative III.
		Blasting during adit construction would generate sounds up to 125 dBA within 900 feet of the blast and 60-80 dBA within the Clark Fork Valley and the CMW. Construction equipment would generate sounds up to 110 dBA within 50 feet.	Similar to Alternative II except that sound mitigations to construction equipment could reduce noise levels.	Same as Alternative III except that moving the mill to the confluence would increase the buffer between the mill/mine operations and the CMW to 1.25 miles. Noise levels would be about 35 dBA at the CMW boundary.	Same as Alternative IV.
		Mine operation noise levels of 52-62 dBA are lower than construction noise levels but still greater than premine conditions and would generally be inaudible in Clark Fork Valley.	Implementation of sound mitigations (e.g. reduce backup beeper volumes, dampen exhaust and intake fan, and retain vegetative buffers) would reduce operation noise levels.	Same as Alternative III.	Same as Alternative III.
		Traffic related noises would significantly increase on FDR No. 150 from 30 to 70 dBA.	**Similar to Alternative II.**	**Similar to Alternative II.**	Busing of mine employees would reduce traffic frequency by 72 percent compared to Alternative II. This would in turn reduce the frequency of traffic-related noise.
Noise		**Activities at the Hereford rail load-out facility would generate noise up to 87 dBA daily between 8 a.m. and midnight. This would increase noise levels to residences in the area.**	Noise-related impacts to Hereford residences would be avoided by moving the rail load-out to the Miller Gulch site. Sound levels at Miller Gulch would be similar to those at Hereford (Alternative II), but there are no nearby residences that would be impacted.	Same as Alternative II.	Same as Alternative II.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
		Ventilation fans would operate continuously at about 123-96 dBA and would be heard at about 45 dBA up to a mile away (450 acres) for the last 15-20 years of mine operation. This would significantly affect the solitude expected by people visiting the area of the CMW near the adit.	Relocation of the ventilation adit and sound mitigations for the ventilation fans would reduce the noise level to 30 dBA within 100 feet of the adit, and effect an estimated 12 acres. This reduces the impact to CMW visitors.	Same as Alternative III.	Same as Alternative III.
Scenic quality	Visual character of the Rock Creek drainage and the Clark Fork Valley would be retained.	**Significant impacts to Rock Creek drainage and Clark Fork Valley from project features during construction and operation.**	**Significant impacts somewhat reduced by painting or staining mill facilities and immediate revegetation of cut slopes and waste rock dumps.**	**Similar to Alternative III except impacts at confluence mill site further reduced by visual buffer along FDR No. 150 and immediate revegetation of mill pad face following construction.**	**Same as Alternative IV.**
		Impoundment visibility would significantly impact travelers on MT Hwy. 200 due to lack of screening and postponement of planting trees until after mine closure and topographic changes.	Impoundment visibility along MT Hwy. 200 reduced by planting vegetative screen and concurrent planting of trees and shrubs after year 7 of impoundment construction.	Same as Alternative III.	Paste facility visibility along Montana Hwy. 200 reduced by vegetative screen. Phased reclamation of deposit incrementally reduces deposit visibility, but effectiveness varies with deposition options.
		Impoundment surface highly visible in background for CMW users on high trails and peaks.	Similar to Alternative II, but long-term visibility reduced due to changes in revegetation plan.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE S-3 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Scenic Quality (Cont.)		Utility corridor visible to people using FDR No. 150.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II but pipelines buried except at stream crossings.
	Forest Plan Visual Management System (VMS) and Visual Qualtiy Quality Objectives (VQO) would be used for future timber sales or other KNF management activities.	**The proposed VMS VQOs would be impossible to achieve during mine life and/or VQO time frames.**	**Same as Alternative II.**	**Same as Alternative II.**	**Same as Alternative II.**
		The impoundment surface could potentially never meet Retention VQO standards.	**Additional reclamation requirements would increase the likelihood the impoundment surface would achieve VQO standards within several decades.**	**Same as Alternative III.**	**Same as Alternative III.**
		The impoundment face, mill site and utility corridor might achieve prescribed VQOs several decades after mine closure.	**Additional plantings for screening, concurrent planting of trees and shrubs on impoundment face after year 7 of construction, and other additional reclamation requirements would shorten the amount of time needed for mine facilities to achieve VQO standards, but it would still take decades.**	**Similar to Alternative III, except that the elimination of the waste rock dump, immediate planting of the mill pad face, and the visual buffer would further help the site achieve VQO standards after several decades.**	**Same as Alternative IV.**
Wilderness	Current wilderness experience remains unaffected.	**The wilderness ventilation adit would be highly visible and audible to recreationists using the CMW within 2,500 feet of the adit. The adit would significantly affect the wilderness experience of those users (see Noise above).**	Placing the ventilation adit in a more vertical slope could increase its visibility, but would reduce the area of disturbance around the adit. Additional reclamation requirements would dramatically reduce the visual impacts of the adit after mine closure.	Same as Alternative III.	Same as Alternative III.
			Sound mitigations would reduce the noise-related impacts to humans and goats to a 100-foot radius around the adit.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

CHAPTER 1

THE PURPOSE, NEED, AND PERMITTING PROCESS FOR THE ROCK CREEK PROJECT

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CHAPTER 1: THE PURPOSE, NEED, AND PERMITTING PROCESS FOR THE ROCK CREEK PROJECT

INTRODUCTION

This supplement to the draft Environmental Impact Statement (EIS)[1] for the Rock Creek Project has been prepared to analyze the possible environmental consequences of a proposed action and a new alternative prepared in response to issues and comments raised during public review of the draft EIS (see **Chapter 2** for details regarding alternative development). The supplement is needed because there is substantial, additional information that has been collected that may change the basis for the Agencies' decisions regarding the Rock Creek Project. ASARCO Incorporated's (ASARCO) proposed action -- the construction and operation of the Rock Creek Project -- and one new alternative have been analyzed in this supplemental EIS. Alternatives III and IV remain as described in the draft EIS. The purpose and need for the proposed action; the EIS process; the agencies' roles, responsibilities, and decisions; and public participation for the Rock Creek Project are described in this chapter.

PURPOSE AND NEED FOR THE PROPOSED ACTION

ASARCO has determined that the Rock Creek deposit is a valuable mineral deposit containing copper and silver. The 1872 Mining Law gives ASARCO the right to mine this deposit and remove the copper and silver. ASARCO's purpose is to make a profit from the mining and milling of copper and silver from the Rock Creek deposit. Society needs and demands these metals for a variety of purposes, ranging from industrial and medical purposes to personal items, such as jewelry.

ASARCO proposes to construct, operate, and reclaim all facilities necessary to mine, remove, and transport economically minable minerals from the Rock Creek deposit. The Rock Creek Project consists of developing a proposed underground copper/silver mine and mill/concentrator complex in northwestern Montana. The project is proposed and would be operated by ASARCO in Sanders County, Montana (see **Figure 1-1**). The Rock Creek ore deposit is located, beneath and adjacent to the Cabinet Mountains Wilderness (CMW) in the Kaniksu National Forest. The Kaniksu National Forest (within Montana) is administered by the Kootenai National Forest (KNF). The mill and other facilities would also be located within the Kaniksu National Forest in Sanders County. Access to the proposed project site would be via Montana Highway 200, then approximately 6 miles up Rock Creek Road (Forest Development Road No. 150).

An exploration adit would be driven for sampling the ore body and for exhaust ventilation during mining. The mineralized zone under the CMW would be accessed through twin adits driven from outside the wilderness area. A fourth adit may be constructed for ventilation intake with a portal in the CMW. The underground mining operation would use a room-and-pillar mining method where pillars of ore are left in place to support the rock above the room (see Chapter 2, Mine Plan and the draft EIS). The milling process would use a conventional froth flotation process, producing a copper/silver-based concentrate that would be shipped to a smelter by rail. The material left after copper and silver are

[1] Hereinafter the "supplement to the draft EIS" will be referred to as either the "supplement" or "supplemental EIS."

FIGURE 1-1 Location Map Rock Creek Project, Sanders County, Montana

extracted is called "tailings"; tailings would be deposited in a tailings impoundment behind an embankment.

The 1872 General Mining Law, as amended, allows U.S. citizens the right to locate, explore, and develop mining claims on federal lands, such as national forests, that are open to mineral entry; or, if closed to mineral entry, subject to valid existing rights. Additionally, the Alaska National Interest Lands Conservation Act guarantees access to private inholdings to secure the owner the reasonable use and enjoyment thereof..." Also, the Wilderness Act of 1964 provides and allows surface disturbing activities that are reasonably incident to mining or processing operations when valid rights have been found to exist. ASARCO perfected its rights to the Rock Creek deposit within the CMW by patenting most of its lode mining claims. ASARCO asserts its rights to mine the deposit and use federal lands for milling and storage purposes through both patented and unpatented mining claims as well as ASARCO fee lands.

Copper/silver mineralization in the Rock Creek drainage within the Cabinet Mountains was discovered in 1963 by Bear Creek Mining Company during regional reconnaissance. In 1964, the Cabinet Mountains were made part of the national wilderness system. The Wilderness Act allowed mineral exploration through December 31, 1983. From 1966 to 1973, Bear Creek Mining Company drilled 10 holes to further verify the discovery. In 1973, ASARCO acquired the rights to the property as part of the lease agreement for the Troy Mine property. In the same year, a program of geological mapping, geochemical sampling, and drilling was started. The exploration program ended in 1983 and culminated with a total of 121 drill holes.

On January 1, 1984, the wilderness was withdrawn from mineral entry under provisions of the Wilderness Act, subject to valid existing rights. The Wilderness Act requires the Forest Service to assure that valid rights exist prior to approving mineral activities inside a congressionally-designated wilderness area. To establish valid existing rights, mining claimants must show they have made a discovery of a valuable mineral deposit on the claim(s) prior to the withdrawal date, and maintain that discovery. In 1985, the Forest Service determined that ASARCO had established valid existing rights to the deposit. In 1989, the Bureau of Land Management (BLM) responded to ASARCO's patent application by issuing patents to 99 lode mining claims (1,686 acres within the CMW and 123 acres outside but adjacent to the CMW). ASARCO received a patent only to the minerals within the wilderness with the federal government retaining the surface rights. For those claims outside the wilderness, ASARCO received fee title (surface and mineral rights). These patented mining claims contain the ore reserves ASARCO has proposed to mine.

ASARCO also controls at least 189 unpatented lode mining claims and/or mill sites as of June 1997 and owns 754 acres of fee land within the proposed project area (see **Chapter 2, Mine Plan**). Unpatented mining claims are lands where primary title still rests in the United States, but the claimants may hold a real property interest that could entitle them to such things as:

- removal of valuable mineral deposits;
- siting of mill and waste facilities; and
- being granted title (patent) to the claims.

On May 6, 1987, ASARCO submitted a Plan of Operations/Application for a Hard Rock Operating Permit to the KNF and the former Montana Department of State Lands (DSL)[2]. This multi-volume document was intended to meet the requirements of both agencies. ASARCO's permit application contains environmental baseline information and operation and reclamation plans. Descriptions of proposed mining and milling methods, engineering designs, surface facilities, waste disposal practices, erosion and pollution control systems, reclamation methods, and environmental monitoring procedures are included. The application was initially deemed complete by KNF and DSL on November 17, 1989. In June 1992, ASARCO submitted an application to KNF and DSL for the development of an evaluation adit[3]. The exploration license application was determined to be complete on July 26, 1993. Both these documents are available for public review at the Montana Department of Environmental Quality (DEQ) and KNF offices and selected libraries in the project area. A decision on both the mining permit and exploration applications will be made after the EIS process is complete.

THE EIS PROCESS

KNF is required to comply with the National Environmental Policy Act (NEPA) regulations (40 CFR parts 1500 to 1508) to minimize adverse environmental impacts on National Forest surface resources through informed decision making. Compliance with all other applicable federal and state laws and regulations is also mandatory. Furthermore, KNF would take all practical measures to harmonize operations with scenic values and maintain and protect fisheries and wildlife habitat that may be affected by the operations. KNF must also ensure timely interim and final reclamation on National Forest System (NFS) lands.

DEQ must comply with the Montana Environmental Policy Act (MEPA) regulations (ARM 17.4.101 through 17.4.725). DEQ requires protection of air and water quality as well as successful interim and final reclamation of disturbed areas, and compliance with other applicable federal and state laws and regulations.

The draft EIS and this supplemental EIS present the Agencies' analysis of environmental impacts under NEPA and MEPA regulations and guidelines. The Agencies will use these analyses to make final decisions concerning the approval of the operating permit and the plan of operations (see **Table 1-1**). Under NEPA and MEPA, KNF and DEQ are required to consider reasonable alternatives to a proposed project. The selected alternative will be in compliance with U.S. Army Corps of Engineers (COE) and U.S. Environmental Protection Agency's (EPA) regulations and guidelines (33 CFR, Appendix B, 40 CFR 230, 404 (b)(1) guidelines).

Procedures governing the EIS process in Montana are defined in administrative rules implementing NEPA and MEPA. These laws require that if any action taken by the federal government or the state of Montana may "significantly affect the quality of the human environment,"[4] an EIS must be prepared. The

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[2] The Reclamation Division of the Department of State Lands was merged with portions of the Department of Natural Resources and Conservation and portions of the Department of Health and Environmental Services on July 1, 1995, to create the Department of Environmental Quality (DEQ).

[3] In 1992, several years after submitting an application for a Hard Rock Operating Permit and proposing a plan of operations to the Forest Service, ASARCO applied to DSL for an exploration license to access their ore body via an adit. The purpose of the adit is to evaluate the ore zones and structures, obtain rock mechanics data, and to obtain a bulk ore sample for metallurgical testing (ASARCO, Incorporated 1992). Throughout the supplemental EIS, the Agencies refer to this adit as ASARCO's evaluation adit.

[4] As defined in 40 CFR 1508.27 and ARM 26.2.644.

draft EIS and this supplement to the draft EIS were written to meet the requirements of these statutes and the administrative rules and regulations implementing these laws.

Supplemental EISs are required under MEPA and NEPA when the need for new information is "substantial," or there are significant new circumstances that change the basis for the Agencies' decisions, or there is "substantial change" in the proposed action (40 CFR 1502.9(c) and ARM 17.4.621). A supplemental EIS must be circulated for public review and comment before proceeding with a final EIS and the Agencies' decisions. Substantive comments on the supplemental EIS as well as those received on the draft EIS will be addressed in the final EIS.

ASARCO has not made changes to its proposed mine permit application, so the last reason for a supplemental EIS listed above does not apply. DEQ and KNF, however, determined that some new information obtained in response to public comments on the draft EIS would result in a substantially new alternative that needed to be presented to the public for review and comment prior to release of a final EIS.

The draft and supplemental EISs will be merged and modified in response to public comments to develop the final EIS. The final EIS will be released to the public and will be used by the Agencies to make decisions on the proposed action or alternatives.

AGENCY ROLES AND RESPONSIBILITIES

Two "lead" agencies have been designated for this project: KNF and DEQ (the Agencies). A single EIS for the Rock Creek Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. In addition to approvals by the Agencies required for the Rock Creek Project, various other permits, licenses, or approvals from DEQ and other agencies also would be necessary (see **Table 1-1**) prior to construction and operation of the proposed project. The roles and responsibilities of the agencies with primary environmental permitting and regulatory responsibilities are discussed in the following sections.

Lead Agencies

Kootenai National Forest

A majority of the proposed Rock Creek Project facilities and most of the ore deposit are on or under lands administered by KNF. The Organic Administration Act authorizes the Secretary of Agriculture to regulate occupancy and use of NFS lands for the protection and management of forest resources. Regulations for mining and reclamation activities on NFS lands are contained in 36 CFR Part 228, Subpart A (36 CFR 228A). These regulations require submittal and approval of a proposed plan of operations for mining related activities that could result in significant disturbance to surface resources. Regulations for special uses on NFS lands are contained in 36 CFR 251. These regulations require that a special use application be filed for uses such as constructing and operating a transmission line. Both sets of regulations require that an applicant describe the proposed operation, environmental protection

TABLE 1-1
Permits, Licenses, and Approvals Required for the Rock Creek Project.

Permit, License or Approval	Purpose
	Federal Agencies
	Kootenai National Forest
Approval of Plan of Operation (36 CFR 228A)	To allow ASARCO to construct and operate a mine and related facilities on NFS lands. Approval incorporates management requirements to minimize or eliminate effects on other forest resources which includes final design of facilities, and mitigation and monitoring plans. Coordinated with DEQ and other appropriate agencies. KNF approval is documented in a ROD. Plan approval comes later, contingent on KNF approval of final designs and plans prior to project implementation.
Special Use Permit(s)	To allow respective utility companies to construct and operate electric transmission/distribution and telephone lines and to allow ASARCO to construct and maintain associated facilities such as a weather station or radio tower outside the designated project area on NFS lands.
Road Use Permit	To specify operation and maintenance responsibilities on National Forest roads used for commercial hauling of ore concentrate.
Mineral Material Permit	To allow ASARCO to take borrow material from NFS lands outside mining claims or mill sites.
Timber Sale Contract	To allow ASARCO to harvest commercial timber from the project area within NFS lands. Harvesting would be conducted to clear area for project facilities.
	U.S. Fish and Wildlife Service (USFWS)
Biological Opinion	To evaluate jeopardy to threatened and endangered species. Consultation with KNF.
404 Permit	Evaluates 404 Permit to prevent loss of, or damage to fish or wildlife resources.
	U.S. Army Corps of Engineers
404 Permit (Clean Water Act)	To control discharge of dredged or fill material into waters of the U.S. including wetlands. Reviewed by EPA, USFWS, DEQ.
	State and Local Agencies
	Department of Environmental Quality
State Hardrock Mine Operating Permit (Metal Mine Reclamation Act)	To allow mine development activities. Proposed activities must comply with state and federal environmental standards and criteria. Approval may include stipulations for final design of facilities and monitoring plans. Coordinate with KNF.
Reclamation Bond	To post a sufficient bond with the state prior to starting construction after operating permit issuance. Coordinate with KNF and COE.
Air Quality Permit (Clean Air Act)	To control particulate emissions of more than 25 tons per year.
MPDES Permit (Water Quality Act)	To establish effluent limits, treatment standards, and other requirements for point source discharges to state waters including groundwater. Discharges to surface waters may not violate downstream states water quality standards. Coordinate with EPA and State of Idaho.
Storm Water Discharge Permit (Water Quality Act)	To control discharge of storm waters from the mine site (may be merged with MPDES permit).
Public Water and Sewer Permit	To allow construction of public water and sewer system and to protect public health.

Table 1-1. Permits, Licenses, and Approvals Required for the Rock Creek Project (Cont'd)

Permit, License or Approval	Purpose
Water Quality Waiver of Turbidity (3A Waiver)	To allow for short-term increases in surface water turbidity during construction. Request may be forwarded from DFWP.
401 Certification (Federal Clean Water Act)	To ensure that any activity that requires a federal license or permit (such as the 404(b)(1) permit from COE) complies with Montana water quality standards.
Hazardous Waste Registration	To ensure safe transport of hazardous materials to and from the site.
	Department and Board of Natural Resources and Conservation
Water Rights Permit (Montana Water Use Act)	To allow beneficial use of state waters obtained through any surface water diversion over 35 gallons per minute (gpm) or through ground water withdrawal exceeding 100 gpm.
Timber Harvest	To ensure best management practices are used during timber harvest on private and state lands.
Burning Permit	To regulate slash burning from land clearing during construction.
	State Historic Preservation Office
Cultural Resource Clearance (Section 106 Review)	To ensure appropriate protection of cultural resources (archeological and historic) coordinated with KNF.
	Department of Fish, Wildlife and Parks (DFWP)
310 Permit (Natural Streambed and Land Preservation Act)	To allow construction activities by non-government entities within the mean high water line of a perennial stream or river. Works with conservation districts to review permit and determine if a 3A waiver from DEQ is needed.
	Montana Department of Transportation
Business Approach Permit	To allow safe connection of roads to state highways.
	Hard Rock Impact Board/Sanders County
Fiscal Impact Plan (Hard Rock Mining Impact Act)	To mitigate fiscal impacts on local government services.
	Green Mountain Conservation District
310 Permit (Natural Streambed and Land Preservation Act)	To allow construction activity by non-government entities within the mean high water line of a perennial stream or river.
	Sanders County Weed District
Noxious Weed Management Plan	To prevent propagation of noxious weeds.

measures, and reclamation plans. Several additional permits associated with a variety of uses are required.

The KNF Supervisor will issue a decision on ASARCO's proposal in a Record of Decision (ROD) (see Agency Decisions). ASARCO may appeal the decision pursuant to 36 CFR Part 215 or 251. Other parties may appeal the decision pursuant to 36 CFR Part 215.

KNF would share responsibility for monitoring and inspecting the Rock Creek Project with DEQ. KNF also has authority to ensure that impacts to surface resources on NFS lands are minimized by modifications to an approved plan of operations. Both KNF and DEQ have authority to require a bond to ensure that the lands involved with the mining operation are reclaimed in accordance with the approved reclamation plan. (DEQ's bonding is discussed in a subsequent section.) The bond would be held to ensure compliance with the state permit and Forest Service-approved plan of operations. KNF may require an additional bond if it determines that the bond held by DEQ is inadequate to reclaim NFS lands or would be administratively unavailable to meet Forest Service requirements.

KNF is required by the Endangered Species Act to ensure that any actions it approves will not jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat. KNF has prepared a draft biological assessment that evaluates the potential effect on threatened or endangered species that may be present in the area. The evaluation includes any measures KNF believes are needed to minimize or compensate for effects on the species. The biological assessment was presented in Appendix B in the draft EIS. A revised biological assessment is presented in **Appendix B**. The revised biological assessment has been submitted to the USFWS as part of an informal consultation process. In addition, KNF is required by the National Forest Management Act to maintain viable populations of sensitive species and to prepare biological evaluations to analyze impacts on them. If the biological Evaluation identifies any unmitigated, significant effects the Forest Supervisor will need to make a decision to allow or disallow the impact(s). If the significant effects result in a loss of species viability or creates a significant trend toward Federal listing, the Forest Supervisor cannot issue the permits that would allow the project to proceed (Forest Service Manual 2672.32-4).

Montana Department of Environmental Quality[5]

Permitting and Compliance Division. DEQ administers the Montana Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3, MCA), under which ASARCO has applied for a mine operating permit (ASARCO, Incorporated 1987-1994). DEQ also administers the Montana Clean Air Act (75-2-101 et seq., MCA), the Montana Water Quality Act (75-5-101 et seq., MCA), the Montana Hazardous Waste Act (75-10-401 et seq., MCA), and the Solid Waste Management Act (75-10-201, et seq., MCA). In addition, DEQ provides 401 certification for the COE regarding ASARCO's 404 permit application (see U.S. Army Corps of Engineers).

Hard Rock Operating Permit. The purpose of the Metal Mine Reclamation Act is to prevent land and surface water degradation by requiring lands disturbed by mining, whether they are federal, state, or private, to be stabilized and reclaimed. This act requires an approved operating permit for all mining activities on non-Indian lands that disturb more than 5 acres, or mine more than 36,500 tons of ore annually.

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[5] DEQ was created on July 1, 1995 and integrated portions of DSL, DHES, and DNRC that pertained to environmental regulatory management, permitting, enforcement, and protection.

DEQ must decide whether to issue ASARCO an operating permit, and if so, under what conditions (see Agency Decisions). The Director of the Department of Environmental Quality may make a decision to approve ASARCO's permit application no sooner than 15 days following publication of the final EIS. A reclamation performance bond must be posted with DEQ before an operating permit may be issued.

DEQ is authorized to bond mining operations under the Metal Mine Reclamation Act (82-4-338, MCA). The bond amount (established by DEQ and KNF) must be sufficient for the state to complete reclamation in case of default by ASARCO. DEQ reclamation bonds include the cost of returning the site to comparable stability and utility, and other assurances that there would be no continuing impacts to the environment. Consequently, neutralization of chemicals or long-term water treatment are often a part of the bonding calculations. Bonding for water management and treatment is based on the volume of water that must be managed and/or treated, expected water quality, and the method to be used. The bond could be in the form of a trust fund or other mechanism to cover possible long-term facility maintenance and operation.

The amount of bond for reclamation is site specific. Calculations are based on the costs of reclaiming roads, parking lots, embankments, diversion channels, ponds, impoundments, and other facilities. Costs involve replacing topsoil on all disturbed areas. Costs for reclamation depend on the volume of material required for regrading, the distance the material must be moved, and volumes of and distances to move topsoil for proper placement. In addition, if any capping materials or other special handling or treatment are required as a part of the reclamation plan, those volumes and distances hauled are part of the calculation. Bond calculations also include the costs of revegetation, fertilization, repair and maintenance of reclaimed areas damaged by erosion and other acts of nature, temporary irrigation, demolition and removal of buildings and other structures, portal plugging, and restriction of access to the site. Bonding includes yearly monitoring and laboratory testing as well as on-going active water treatment for as long as necessary after mine closure, and costs for reasonably foreseeable accidents. The calculations also include a minimum 15 percent overhead costs. The bond must be submitted by the applicant prior to permit issuance. Bonds are calculated by the Agencies once an alternative has been approved. The calculation would then be on file and available for public review. Bonds are re-evaluated at least every 5 years (ARM 17.24.107U(1)).

A detailed reclamation bond cost estimate for the Rock Creek project has not been generated at this time. Customarily this is done if and when a permit is authorized, and would include the details of the permitted alternative and any mitigations or stipulations which may be attached. Based on similar disturbances at other mines, DEQ estimates that the bond for the Rock Creek project will most likely range between $9,000,000 and $12,000,000.

Major changes in operating or reclamation plans would require prior approval by DEQ and KNF, and may require additional bonding. DEQ would routinely conduct inspections of the Rock Creek Project to ensure compliance with approved plans. Monitoring data collected by ASARCO would be evaluated and, if necessary, additional compliance activities would be implemented. Monitoring activities would be coordinated with other state and federal agencies. DEQ can issue notices of violation and levy civil penalties of up to $1,000 per day of violation to enforce its regulations (82-4-361, MCA).

Air Quality Permit. Any proposed project having estimated pollutant emissions (without emissions controls) exceeding 25 tons per year must obtain an air quality permit. The permit would specify air emissions limitations and monitoring requirements. The applicant must apply Best Available Control Technology to each emissions source, and must demonstrate that the project would not violate Montana or federal Ambient Air Quality Standards. A preliminary determination for an air quality permit based on

Alternative V is included in **Appendix J**. The Air Quality Division would conduct periodic inspections to ensure permit compliance. Civil violations of the Montana Clean Air Act may result in penalties of up to $10,000 per violation per day (75-2-413, MCA) as well as non-compliance penalties (75-2-421, MCA).

Water Quality Permits. The Montana Water Quality Act provides a framework for the classification of surface and ground water uses. It also establishes water quality standards as well as permit programs to control the discharge of pollutants into state waters. DEQ administers Montana Pollution Discharge Elimination System (MPDES) permitting including storm water permits. Mining operations must comply with Montana surface and ground water standards. The tailings impoundment, sewage treatment plant, and other facilities must be constructed and operated to prevent water discharge, seepage, drainage, infiltration, or flow that may degrade surface or ground waters outside of any approved mixing zones.. A short-term exemption from surface water quality standards for turbidity may be required for construction of the powerline and access roads at stream crossings (3A waiver). DEQ has the responsibility for enforcement under the Water Quality Act. Enforcement actions may include civil penalties of up to $25,000 per day of violation (75-5-631, MCA).

ASARCO submitted a revised water management plan and MPDES permit application in March 1995 designed for Alternative IV as described in the draft EIS. ASARCO submitted another water management plan in January 1997 that was developed for Alternative V with paste deposition of the tailings as described in this supplemental EIS. The permit application requests coverage for two sources: a direct discharge to the Clark Fork and the discharge to ground water below the tailings paste facility. A draft discharge permit containing effluent limits and conditions, monitoring requirements, and a ground water mixing zone was released by DEQ in February 1996. The development of new alternatives for this supplement and subsequent changes in the water management plan for Alternative V along with review of public comments on the draft MPDES permit have resulted in the need for preparing a revised draft discharge permit for this alternative. Storm water discharges will also be incorporated into the MPDES permit. This permit also must assure that discharges to surface waters would not violate a downstream state's water quality standards, such as those for the State of Idaho. Discharge permits are issued for a period of up to 5 years and are renewable in 5-year cycles. A public notice will be given upon issuance of the revised draft permit followed by an opportunity for public comment and hearing.

Because of the design of the tailings impoundment and recovery well system, the original discharge permit specified a ground water mixing zone in accordance with Montana's mixing zone rules (ARM 17.30.701 et seq.). A mixing zone would be required for the alternative using paste deposition of tailings. A mixing zone is an area of initial dilution where water quality standards may be exceeded subject to conditions that may be imposed in the permit. Nondegradation does not apply within a mixing zone. Mixing zones must be the smallest practicable size, have a minimum effect on water uses, and have definable boundaries.

Section 401 of the federal Clean Water Act (33 U.S.C. 1251 et seq.) requires that applicants for federal permits or licenses for activities that may result in a discharge to state waters obtain certification from the state. The 401 certification process ensures that discharges that otherwise do not require a state permit comply with applicable state water quality standards and that there would be no violation of state law if a federal permit or license was approved. In Montana, DEQ provides Section 401 certification pursuant to state rules (ARM 17.30.1701 et seq.). DEQ may deny certification for a project if it would violate Montana water quality standards, based on DEQ analysis. DEQ may also certify, certify with conditions, or waiver certification. Certifications may be appealed to the Board of Environmental Review, formerly the Board of

Health and Environmental Sciences, within 30 days of final action by the department. Section 404 dredge and fill permits issued by COE require 401 certification. A joint public notice is issued by COE and DEQ.

Solid and Hazardous Waste Permits and Registrations. DEQ is responsible for reviewing the mine and power line construction and operation plans to ensure implementation complies with solid and hazardous waste laws and regulations. Maximum penalties for hazardous waste violations are $10,000 per violation per day (75-10-417, MCA). Maximum penalties for solid waste violations are $1,000 per violation per day (75-10-214, 228, and 233, MCA).

Other Federal Agencies Having Permit or Review Authority

U.S. Fish and Wildlife Service

USFWS has responsibilities under the Fish and Wildlife Coordination Act (1934), Endangered Species Act (1973), and Bald Eagle Protection Act (1940). Responsibilities under the Fish and Wildlife Coordination Act require federal agencies issuing permits (i.e. Corps of Engineers § 404 Permit) to consult with the Service to prevent the loss of or damage to fish and wildlife resources where "waters of any stream or other body of water are proposed...to be impounded, diverted...or otherwise controlled or modified." The Forest Service must prepare a biological assessment to comply with the Endangered Species Act. A biological assessment evaluates potential effects on threatened and endangered species that may be present in the project area. If the Forest Service determines that the project will require formal consultation because of adverse affects to listed species, the USFWS will render a biological opinion. That opinion will state whether, in the view of USFWS, the action is likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or modification of critical habitat. If USFWS determines that the preferred alternative would jeopardize the continued existence of a species, it must offer a reasonable and prudent alternative that would, if implemented, preclude jeopardy. The USFWS has 135 days from initiation of formal consultation to render the biological opinion.

U.S. Army Corps of Engineers

Tailings disposal and other mine facility construction activities affecting wetlands would constitute the disposal of dredged or fill materials into Waters of the U.S. and would require a "404 permit" under Section 404 of the federal Clean Water Act. COE is the permitting authority for the discharge of dredged or fill materials into the Waters of the U.S. (see **Chapter 3, Waters of the U.S. and Wetlands**). ASARCO submitted a 404 permit application (see the Agencies' evaluation in Appendix C in the draft EIS) to COE (ASARCO, Incorporated 1993) for its proposed project and has submitted an updated application and wetland mitigation plan for the Agencies' preferred alternative identified in this supplement to the draft EIS. The updated 404(b)(1) evaluation is found in **Appendix C**. The COE will document its 404 permit decision in its ROD after release of the final EIS.

COE and EPA have developed guidelines to evaluate impacts from dredged or fill disposal activities on Waters of the U.S. (33 CFR Part 320 and 40 CFR Part 230) and to determine compliance with Section 404 of the Clean Water Act. The guidelines require analysis of "practicable" alternatives that would not require disposal of dredged or fill material in Waters of the U.S., or that would result in less environmental damage. Under the guidelines, the term "practicable" means "available or capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes."

Environmental Protection Agency

EPA has oversight responsibility for federal Clean Water Act programs delegated to and administered by DEQ. EPA may also intervene to resolve interstate disputes where discharges of pollutants in an upstream state may affect water quality in a downstream state. EPA also reviews 404 dredge and fill permit applications and provides comments to COE. EPA has veto authority under the federal Clean Water Act for decisions made by COE on 404 permit applications. EPA also has responsibilities under NEPA and the federal Clean Air Act to cooperate in the preparation of EISs and to review draft EISs and federal actions potentially affecting the quality of the environment. EPA advises the lead agencies on the preparation of an EIS. EPA also evaluates the adequacy of information in the draft EIS, the overall environmental impact of the proposed action, and various alternatives.

Other State and Local Agencies Having Permit or Review Authority

Montana Department of Fish, Wildlife and Parks (DFWP)

DFWP administers the Natural Streambed and Land Preservation Act (75-7-101 et seq., MCA) in cooperation with local conservation districts, and cooperates with DEQ and DNRC in water quality protection matters. DFWP works with the conservation districts to review 310 permit applications and is responsible for determining if a 3A waiver, or short-term exemption from water quality standards from DEQ is needed.

As the lead agency for management of fisheries resources in Montana, DFWP also administers the use, enjoyment, and scientific study of fish. DFWP's approval and designation of a licensed collector as field supervisor would be required for monitoring, mitigation, and transplanting of fish within the project area.

Montana Department of Natural Resources and Conservation (DNRC)

DNRC administers the Montana Water Use Act (85-2-101 et seq., MCA). A water rights permit is required by the Montana Water Use Act for any surface water diversion over 35 gallons per minute (gpm) or a ground water withdrawal exceeding 100 gpm. Because ASARCO proposes to pump water from the Clark Fork alluvium, a water rights permit would be required.

ASARCO must obtain a burning permit from the DNRC area office in order to burn slash or other material.

State Historic Preservation Office (SHPO)

Compliance with federal cultural resource protection laws is required because portions of the proposed project occur on NFS lands. Actions that are permitted, approved, or initiated by the Forest Service and that may affect cultural resources must comply with provisions of the National Historic Preservation Act (NHPA) of 1966, as amended, and as implemented by federal guidelines 36 CFR 800. Section 106 of the NHPA requires a federal agency to take into account the effects of the agency's undertaking on properties listed on, or eligible for listing on, the National Register of Historic Places (NRHP).

Before any federal undertaking begins, cultural resources eligible for listing on the NRHP must be identified and documented. Cultural resources recorded in the project area are evaluated in consultation with

SHPO or the Federal Advisory Council on Historic Preservation (ACHP). Agreements reached between the Forest Service and the consulting parties on eligibility constitute a consensus, allowing the compliance process to proceed. If sites do not meet the criteria of eligibility for the NRHP, no further consideration of cultural resources is necessary and the project may proceed.

If a site meets any of these criteria, the Forest Service is required to determine the effect of the proposed action on the site. Once consulting parties agree on mitigation measures for eligible properties affected and the conditions or stipulations have been met, the project may proceed. During mine construction and operation, the Agencies would oversee compliance with historic preservation and monitoring plans.

Montana Department of Transportation (MDT)

MDT must review requests for an approach road (60-2-201, MCA). This code lists the criteria required to assure a reasonably safe approach road for connection with the state highway system (Steve Herzog, Montana Department of Transportation, personal communication, October 13, 1994).

Hard Rock Mining Impact Board/Sanders County

In 1981, the Montana legislature enacted the Hard Rock Mining Impact Act (90-6-301 et seq., MCA) to assist local governments in handling financial impacts caused by large-scale mineral development projects. The legislature recognized that 1) new mineral development projects may result in the need for local governments to provide additional services and facilities causing a fiscal burden for local taxpayers, before mine-related revenues become available, and 2) some local government units may lack jurisdiction to tax a new development. Therefore, the Hard Rock Mining Impact Board (part of the Montana Department of Commerce), oversees an established process for identifying and mitigating fiscal impacts to local governments. The Board also acts as "referee" in disputes between local governments and project developers.

A public hearing on the impact plan was held on September 22, 1997, in the county where fiscal impacts are forecasted to be the most costly. Sanders County is the lead local governing body responsible for reviewing and commenting on ASARCO's Hard Rock Mining Impact Plan for the Rock Creek Project. However, Lincoln County will probably also review and comment. The Impact Plan process is described in 90-6-307, MCA. An impact plan (ASARCO Incorporated 1997) has been agreed to by the local governments.

The operating permit issued by DEQ is not valid until an impact mitigation plan has been approved by the Hard Rock Mining Impact Board. ASARCO’s impact mitigation plan identifies possible increased public sector costs associated with major mineral development actions. It also contains commitments to prepay taxes and make grants according to a specified time schedule, to accommodate identified capital and net operating costs to local government units that result from project development.

Green Mountain Conservation District

Any mining disturbance occurring within the normal high water level of streams would require the approval of the Green Mountain Conservation District. This approval would constitute a "310 permit" under the Natural Streambed and Land Preservation Act (75-7-101 et seq., MCA). Reconstruction of road drainage structures, habitat improvements, new stream crossings, and creek diversions are examples of

activities needing a 310 permit. Prior to granting approval, the District would consult with KNF and DFWP. DFWP would make a determination if a 3A waiver from DEQ would be required in conjunction with the 310 permit.

Sanders County Weed Board

The weed board administers the County Noxious Weed Control Act (7-22-2101 through 2153, MCA) for any land-disturbing activities within their jurisdiction. ASARCO would be required to submit a weed management plan to Sanders County Weed Board for review and approval.

AGENCY DECISIONS

The lead Agencies have three potential choices for the main decision regarding the proposed project. The first would be to deny or not approve the proposed plan of operations. The second would be to approve the plan of operations as proposed by ASARCO. The last choice would be to approve the plan of operations with some or all of the modifications and mitigations presented in one or more of the agency-developed alternatives along with any additional agency stipulations. Under this type of decision, the permitted activity might look similar to but not exactly like any of the alternatives described in the final EIS.

The decision would be documented in each Agency's ROD, describing its decision and the rationale for the decision. If the proposed plan of operations or an agency-modified alternative was to be approved, the ROD would also identify any required mitigation and monitoring measures and stipulations.

If possible, DEQ and KNF will jointly decide on ASARCO's mine permit application based on information in the draft, supplemental, and final EISs. However, KNF will not issue a ROD on ASARCO's project proposal until after the USFWS makes a decision on jeopardy to threatened and endangered species. COE will approve or deny the 404 permit after KNF issues its ROD. Approvals would be based on information in this document and compliance with other state and federal environmental laws.

Grounds for DEQ denial would be a finding that the mining or reclamation plans would violate the Metal Mine Reclamation Act (MMRA) or the water and air quality laws administered by DEQ. In addition, since 1982 DEQ and the courts have interpreted MEPA as supplementing the basis upon which an operating permit under MMRA may be conditioned or denied. This means that DEQ may also deny or modify the mine operating permit under MMRA in order to avoid or mitigate an impact that would significantly degrade the human environment.

No authority exists for the Forest Service to deny ASARCO the right to develop the ore deposit unless its plan of operations violates laws. A plan of operations, however, must meet the purpose of the Forest Service locatable mineral regulations as described in 36 CFR 228A. These regulations state, in part, that all operations shall be conducted, where feasible, to minimize adverse environmental impacts on National Forest surface resources, including complying with all applicable federal and state air and water quality standards, and standards for the disposal and treatment of solid wastes. All practicable measures must be taken to harmonize operations with scenic values and maintain and protect fisheries and wildlife habitat that may be affected by the operation.

If the USFWS decides, in its official biological opinion, that the project could not be conducted without jeopardizing the continued existence of bull trout or may affect a threatened or endangered species,

the Rock Creek Project cannot proceed unless an exemption is granted by the USFWS or the project is modified to meet USFWS reasonable and prudent measures. COE can deny a 404 permit if the project would result in significant environmental impact or violate provisions of the federal Clean Water Act.

PUBLIC PARTICIPATION

Public participation has been a key element in preparing the draft EIS as well as this supplement to the draft EIS (see **Table 1-2**). The first opportunity for public involvement occurred in the beginning of the EIS process when "scoping" was conducted. Scoping is a process designed to identify a broad list of environmental issues related to the proposed action. Scoping was again conducted when preparation of the EIS was resumed after a 4-year lapse. The Agencies determined significant issues from those identified during the two scoping periods. The subsequent analyses presented in this EIS focus on the identified significant issues. A summary of issues relating to this supplemental EIS is presented in Chapter 2.

Meetings and hearings were held for public participation on the draft EIS and the draft MPDES permit. Approximately 2,000 comments were received on the draft EIS and draft MPDES permit. Additional information was obtained as a result of public comments. Agency review of this information has resulted in the need to prepare and submit a supplemental EIS for public comment and review prior to preparation and release of a final EIS.

TABLE 1-2
Public Meetings

May 26, 1987	Public information meeting held on ASARCO's application in Noxon, Montana
January 27, 1988	Public scoping meeting on ASARCO's application at Noxon, Montana
March 22, 1990	Public meeting on ASARCO's petition to amend ambient water quality at Noxon, Montana
June 16, 1993	Public scoping meeting in Noxon, Montana
June 28, 1993	Public scoping meeting in Sandpoint, Idaho
October 5, 1995 to December 5, 1995	Public comment period on draft EIS
November 14, 1995	Open house and public hearing on draft EIS in Noxon, Montana
November 15, 1995	Open house and public hearing on draft EIS in Sandpoint, Idaho
February 20, 1996 to April 22, 1996	Public comment period on draft MPDES permit and water-quality related portions of draft EIS
April 8, 1996	Public meeting on draft MPDES permit in Noxon, Montana
April 9, 1996	Public hearing on draft MPDES permit in Noxon, Montana
April 10, 1996	Public meeting on draft MPDES permit in Sandpoint, Idaho
April 11, 1996	Public hearing on draft MPDES permit in Sandpoint, Idaho
April 22, 1997	Public town meeting in Sandpoint, Idaho, to discuss new alternatives in supplemental EIS
April 23, 1997	Public town meeting in Noxon, Montana, to discuss new alternatives in supplemental EIS

CHAPTER 2

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CHAPTER 2: DESCRIPTION OF ALTERNATIVES

INTRODUCTION

This chapter summarizes ASARCO's proposed plan for its Rock Creek Project, a copper/silver mine, mill, tailings storage facility, and evaluation adit. For more detail, refer to the October 1995 draft EIS. Reasonable alternatives to the proposed action that were not described and analyzed in the draft EIS are also described. Part I of this chapter, Issues and Development of Alternatives Process, summarizes how the Kootenai National Forest (Forest Service) and Department of Environmental Quality (DEQ) (the Agencies) developed alternatives analyzed in this supplement to the draft EIS. Part II, Description of Alternatives, describes ASARCO's project proposal and one alternative not covered in the draft EIS as well as the no-action or permit denial alternative. Part III, Alternatives Considered but Dismissed from Further Study, describes alternatives considered but dismissed from detailed analysis in this supplemental EIS as well as the rationale for their dismissal and summarizes the alternatives considered but dismissed in the draft EIS. Part IV, Description of Reasonably Foreseeable Activities, discusses and summarizes the reasonably foreseeable future activities included in the project area. These include the relicensing of the Washington Water Power dams and the implementation of the Tri-State Implementation Council's management goals for the lower Clark Fork River and Lake Pend Oreille as well as the Montanore Project, and other activities previously described in the draft EIS. Part V, Comparison of Alternatives, compares the features and impacts of each alternative described in this chapter and analyzed in Chapter 4 to the issues used for alternative development. Part VI identifies the Agencies' new preferred alternative.

PART I: ISSUES AND DEVELOPMENT OF ALTERNATIVES PROCESS

Identification of Issues

The Agencies identified the significant issues that would be used as criteria in defining and evaluating the alternatives from written comments and a series of public and agency meetings. Eight issues, defined as indicators of potentially significant effects, emerged from the scoping process and Agencies' discussions. No new issues were identified from public comments on the draft EIS. However, public comments focused on effects on quantity and quality of surface and ground water, tailings impoundment stability, and visual impacts of the impoundment. The effects have the potential to be adverse or beneficial, to be severe or long-lasting, to affect a large area, or to occur frequently when a resource's quantity, quality, fragility, or uniqueness are considered. The description of each issue and the means for predicting its associated impacts are provided below and do not represent a conclusion about the effects of the project. **Issues marked with a dot ("●") are the primary issues covered in the supplemental EIS.**

Issue 1: Effects on quantity and quality of Montana and Idaho surface and ground water resources.

- Discharges and activities associated with the Rock Creek Project may change the ambient (existing) surface water quality of Rock Creek, the Clark Fork River, and Lake Pend Oreille, and ground water quality. *Effects will be predicted by estimating changes in selected water quality parameters of surface and ground waters and changes in the composition and abundance of aquatic life.*

- Seepage from the tailings impoundment/paste facility may alter ambient ground and surface water quality. *Effects will be predicted by estimating changes in selected ground water quality parameters of selected wells.*

  The proposed water withdrawals and diversions may affect existing water users. *Effects will be predicted by estimating changes in concentrations of selected parameters and the quantity of water available for users.*

  Seepage into underground mine workings may affect water levels in wilderness lakes, wetlands and flow rates of springs. *Effects will be predicted by estimating mine inflow and changes in lake levels and spring flows.*

Issue 2: Effects on fish and wildlife and their habitats and current and proposed threatened and endangered species.

- The proposed mining activities and mining support activities may adversely affect grizzly bear (threatened species) because of direct habitat loss, displacement, disruption of travel routes, and increased mortality. *Effects will be predicted by estimating changes in open road density (miles of open road per square mile) and percent of each bear management unit that provides seclusion from humans.*

  The proposed mining activity and mining support activities may adversely affect big game because of habitat loss or degradation, displacement, disruption of travel routes, and increased mortality risk. *Effects will be predicted by estimating changes in open road density, habitat quality, and mortality risk.*

  The proposed mining activities and mining support activities may affect neotropical migrant birds from habitat change, loss, or degradation and displacement and/or replacement of species using the area. *Effects will be predicted by estimating acres of habitat altered.*

- The proposed mining activities and mining support activities may adversely affect mountain goats because of habitat loss or degradation, displacement, disruption of travel routes, and increased mortality risk. *Effects will be predicted by estimating acres of habitat altered and changes in habitat quality and mortality risk.*

- Disturbance from the proposed mining activities may affect other threatened and endangered species (bald eagle, peregrine falcon, and grey wolf) currently using the area. Threatened and endangered species may be subject to adverse habitat modification as well as to an increased mortality risk. *Effects will be predicted by estimating acres of habitat affected and changes in open road density.*

- The proposed mining and support activities may adversely affect sensitive animal species (harlequin duck, fisher, lynx, wolverine, Coeur d'Alene salamander, northern bog lemming, Townsend's big-eared bat, black-backed woodpecker, flammulated owl, and boreal owl) due to habitat loss or degradation, displacement, disruption of travel routes, and increased

mortality. *Effects will be predicted by estimating acres of altered habitat and changes in habitat quality and mortality risk.*

- The proposed mining and support activities may affect sensitive fish species (westslope cutthroat and bull trout) and/or those proposed for listing as threatened. The effects on these species could include habitat loss or degradation, and increased mortality risk. *Effects will be predicted by estimating changes in surface and ground water parameters, changes in habitat quality, changes in abundance and composition of aquatic life, long term population trends, reproduction success, and growth rates of fish species.*

Issue 3: Stability of the tailings impoundment/paste facility.

- Failure of the tailings impoundment/paste facility may have substantial adverse effects on water quality, public safety, aesthetic quality, downstream facilities, aquatic life, and long-term reclamation success among others. A comprehensive Quality Control/Quality Assurance program should be part of any proposed design. Probability of failures can be measured by documenting foundation strength parameters, tailings properties, and seismic response. Phreatic surface location and associated seepage analyses will also be used in the technical review of the impoundment design. *Effects of failure can be predicted by estimating impacts to surface waters and aquatics/fisheries as described above.*

Issue 4: Impacts to socioeconomics of surrounding communities.

The proposed project may affect local employment, local income, the size and location of the area population, school, fire, public safety and other public services, local tax revenues, and public expenses. *Effects will be predicted by estimating changes in employment, population, demographics, government services, local economies, and fiscal condition in Sanders and Lincoln counties, Montana; and Bonner County, Idaho.*

Issue 5: Effects on old growth ecosystems.

- The proposed project may impact old growth stands. *Effects will be predicted by estimating the acres of old growth directly lost, changes in old growth effectiveness, and changes in designated Forest Service old growth.*

Issue 6: Effects on Waters of the U.S. and wetlands.

- The proposed project may destroy or affect wetlands and Waters of the U.S. *Effects will be predicted by estimating the number of acres destroyed, dewatered, or otherwise affected and by the loss/decrease/change in functions and values of the affected wetlands and Waters of the U.S.*

Issue 7: Effects on public access and traffic safety.

The proposed project could adversely impact public recreational access and use patterns such as hunting, berry picking, camping, sightseeing, and hiking. *Effects will be predicted by estimating the number/miles of roads closed/opened.*

Public safety is a primary concern on proposed service roads and Montana Highway 200. *Effects will be predicted by estimating changes in average daily traffic.*

Issue 8: Effects on aesthetic quality, including noise, scenic, and wilderness experiences.

The proposed mining and support activities may create noise that exceeds ambient levels. *Effects will be predicted by estimating changes in dBAs (decibels in the A scale) and significance of areas exposed to elevated noise levels.*

- The proposed project may change the existing scenic quality and visual character of the Clark Fork Valley and Rock Creek drainage. *Effects will be predicted by the degree of compliance with Forest Service visual quality objectives, by analyzing visual contrast of proposed facilities with the existing landscape, and by estimating reclamation success.*

  The portal of a ventilation adit is proposed in the wilderness. Wilderness users might notice sights, sounds, and smells from the proposed project that could affect their wilderness experience. *Effects will be predicted by those items listed above for noise and scenic quality and by estimating changes in concentrations of air pollutants (particulates and trace metals).*

Development of Alternatives

In an EIS, the Agencies are required to evaluate the environmental effects of the proposed action and reasonable alternatives to it. The Agencies must also consider a no-action alternative.

Alternatives other than the proposed action and the no-action alternative were developed by the Agencies in response to identified environmental issues. The intent of these alternatives was to minimize potential negative environmental impacts by modification of planned operations, mitigation and monitoring plans, and/or relocation of any or all of the proposed project facilities. The development of material needed to prepare responses to public comments on the draft EIS led to the development of one new alternative that is described in this supplement to the draft EIS. The two alternatives developed by the Agencies (Alternative III and IV) and described in the draft EIS are only summarized in this document for general reference. All alternatives include amending the Kootenai National Forest Plan to change Management Area allocations. Reviewers should refer to the draft EIS for detailed information regarding alternatives III and IV.

Alternatives to the proposed action consist of reasonable modifications to various elements of the proposal. These modifications fall into two main categories -- those that modify the location of facilities and those that modify or change the methods and procedures employed in the operation. One or more modifications to different elements were combined in the Agencies' alternatives in order to address the significant environmental issues identified earlier. Mitigations are also proposed in conjunction with these

modifications. **Table 2-1** identifies which issues are addressed by the modifications carried forward into one or more of the Agency alternatives described either in the draft EIS or this supplemental EIS.

Location of Facilities

Alternate locations for each of the facilities were considered in response to issues and concerns associated with their respective location. Alternate locations for a mine portal and mill site, tailings impoundment/paste deposit, ventilation portal, utility and road corridors, rail sidings, and a water treatment plant were considered.

Mine Portal and Mill Site. In 1986, the Forest Service published the Mineral Activity Coordination (MAC) Report detailing the findings of a tailings and mill facility siting study conducted for the Cabinet Mountains (U.S. Forest Service 1986a). This study included an evaluation of various potential tailings and mill facility locations for the proposed ASARCO Rock Creek Project and the now-permitted Montanore Project, and other potential proposals in the south Cabinet Mountains area. The siting study identified seven potential mill sites for the Rock Creek Project: one site on the East Fork Bull River, one site on Copper Creek, and five sites in the Rock Creek drainage. Ultimately, three mill sites in the Rock Creek drainage were further evaluated (see **Figures 2-1 and 2-2**). Only two sites were carried forward as alternative mill sites. The reasons for dismissing the other sites are summarized in this chapter under **Part III: Alternatives Considered but Dismissed From Further Study**.

Tailings Impoundment/Paste Facility. The MAC Report identified potential sites for tailings impoundments based on mill site locations. These same sites were determined to be potential sites for paste deposition of tailings.

The following criteria were applied to screen potential tailings impoundment locations.

(1) Tailings location should be less than 10 miles from the mill site.

(2) Tailings location should be at a lower elevation than the mill site to provide gravity-assisted flow of a tailings slurry.

(3) Tailings location should have relatively gentle terrain (less than 10 percent slopes).

(4) Tailings locations should have foundation conditions that could be reasonably expected to support an impoundment facility.

(5) Use of the tailings location would not require diversion of a major stream.

TABLE 2-1
Modifications Versus Issues

Modifications Carried Forward to One or More Agency Alternatives	**Issues Addressed by Modifications**							
	1: Water	**2**: Fish & Wildlife	**3**: Tailings Stability	**4**: Socio-economics	**5**: Old Growth	**6**: Wetlands	**7**: Traffic Safety	**8**: Aesthetics
Facilities Locations:								
Mine Portal and Mill Site	X	X			X	X	X	X
Tailings Impoundment/ Paste Deposition Siting	X	X	X		X	X		X
Ventilation Adit		X						X
Utility and Road Corridors	X	X			X	X	X	X
Rail Sidings				X		X	X	X
Water Treatment Plant Location		X				X		
Methods and Procedures:								
Water Treatment Systems	X	X						X
Tailings Surface Disposal Methods	X	X	X					X
Modifying the Rail Loadout Facility	X							

FIGURE 2-1 Alternate Tailings Impoundment, Mill, and Portal Sites

FIGURE 2-2 Alternate Mill Site Locations

Potential siting options were also reviewed in detail by ASARCO. These initial reviews considered potential tailings disposal sites in conjunction with several potential locations for the mill facility. Aside from the criteria listed above, ASARCO added a criterion: that there should be a relatively unobstructed transportation corridor between the tailings disposal and mill sites.

As project definition proceeded, the possible locations for the mill were reduced to sites in the Rock Creek drainage, thereby eliminating the three tailings alternatives that were associated with the East Fork Bull River and Copper Creek mill locations. The MAC Report identified four alternative tailings sites for the proposed project with its mill located in the Rock Creek drainage (see **Figure 2-1**). The Agencies determined that only the proposed impoundment site met the MAC Report and ASARCO's criteria, and was large enough to contain all the tailings to be generated by the proposed project and deposited in a tailings impoundment.

Subsequent to the MAC Report, the Agencies undertook another review of tailings impoundment siting options. This review combined construction method with location options to evaluate the potential for constructing specific types of tailings impoundments at several sites and the potential for using two sites simultaneously for tailings disposal. The McKay Creek site (see **Figure 2-1**) was included in this re-evaluation. These reviews are summarized in **Alternatives Considered but Dismissed From Further Study** in Chapter 2 of this supplemental EIS. A more detailed review can be found in Chapter 2 and Appendices E and I of the draft EIS.

The discussion of surface disposal of tailings as a paste was developed during the investigation of paste backfilling of tailings into underground mine workings. The volume of paste tailings remained basically the same as for traditional slurried tailings. The Agencies reviewed the tailings impoundment sites at Rock Creek, McKay Creek, Swamp Creek and Noxon Bench for paste deposition. Criteria for determining suitability of a site for paste deposition include the following items:

(1) Maximum efficient pumping distance of paste was 2,500 feet before additional pumps would be required. The paste plant needed to be relatively close to the tailings deposition location(s).

(2) The greater number of pumps could result in a greater amount of downtime for maintenance and repair. Costs would be greater if many backup pumps had to be available.

(3) Pumping paste from a paste production plant would be done under higher pressures than piping tailings slurry from the mill to the impoundment site (500 pounds per square inch [psi]). Stream crossings and long distances of pipeline could increase the potential for pipeline ruptures and greater potential for impacts than from a ruptured tailings slurry line.

(4) Tailings would need to be slurried from the mill to the paste production plant before being dewatered. This requires a down-gradient paste plant location from the mill.

(5) Deposition locations should have foundation conditions that could be reasonably expected to support the necessary weight of the tailings paste.

(6) The tailings deposition location would not require diversion of a major stream.

Based on these criteria the Agencies determined that only the proposed impoundment site on the west side of Rock Creek and a smaller site on the east side of Rock Creek were suitable for tailings paste deposition. The east side site was only suitable for partial retention of tailings and required that the majority of the tailings be stored on the west side. The dismissal of alternate sites for paste deposition are described in **Part III: Alternatives Considered but Dismissed From Further Study** in this chapter of the supplemental EIS.

Ventilation Adit. The Agencies identified an alternative that would reduce impacts on the Cabinet Mountains Wilderness (CMW) by relocating the ventilation adit to a cliff area to minimize disturbed acreage.

Utility and Road Corridors. ASARCO's proposed mine road and highway intersection does not meet current Montana Department of Transportation (MDT) standards, so an alternative was developed. The Agencies combined road and utility corridors and relocated other mine-related roads, where possible, to minimize other resource impacts.

Rail Sidings. The Agencies analyzed alternatives that met Montana Rail Link criteria. Alternative rail sidings are summarized in **Part III: Alternatives Considered but Dismissed From Further Study**. Ultimately, only one, a site near Miller Gulch was chosen.

Water Treatment Plant Location. ASARCO's proposed water treatment facility was located between the northeast corner of the impoundment and Rock Creek just upslope from the proposed wetland mitigation site at borrow site #3. The Agencies felt that there was a potential for impacts to the effective development and function of the wetland mitigation site with the proximity of the water treatment facility. Alternative sites along FDR No. 150 and the pipeline corridor were investigated. Criteria for selection of an alternate site included (1) keeping the site at least 300 feet from the creek,
(2) keeping the site as close to the highway and the impoundment as possible to help minimize noise and disturbance impacts to wildlife and fisheries, and (3) avoiding additional disturbance to wetlands and Waters of the U.S. as well as old growth timber. The Agencies also wanted to keep the plant either on ASARCO or NFS lands.

Evaluation Adit Support Facilities Site. ASARCO's proposed evaluation adit support facilities site is located close to FDR No. 150 and a stretch of Rock Creek that is considered important harlequin duck habitat. Reclamation of the site could lead to increased public use of the site for camping and access to Rock Creek increasing disturbance of the ducks. ASARCO was asked to provide an alternate site in the vicinity of the tailings paste facility or waste water treatment plant to minimize potential disturbance of harlequin duck habitat.

Methods and Procedures

Alternate methods and procedures for certain operations were also considered in response to issues and concerns. Three operations were identified where different methods or procedures were available for consideration. They were the water treatment system, tailings surface storage methods, and design and operation of the rail loadout facility.

Water Treatment Systems. Water treatment systems proposed in the draft EIS consisted of a semi-passive biotreatment system with an ion exchange backup system. Alternative water treatment methods have

been considered by the Agencies in response to the issues and concerns associated with the proposed operating plan. These include other conventional water treatment facilities such as reverse osmosis, semi-passive biotreatment systems, Land Application Disposal (LAD), constructed wetlands, and segregation of water. ASARCO suggested the changes described in Alternative V of this supplemental EIS in response to public comments on the draft EIS. The revised method of mine discharge water treatment includes pressure filtration, settling sumps, and a semi-passive biotreatment system and a reverse osmosis system. Changes to ASARCO's water monitoring plan have also been developed. ASARCO has proposed collection of seepage from the deposited tailings facility with a perimeter recovery system consisting of drains and if required by DEQ, pump-back wells. Collected tailings seepage would be pumped back to the reclaim pond on the impoundment. Seepage recovery for the tailings paste facility would consist of an underdrain system. Seepage collected from the paste facility would be routed to the mill through the paste plant for reuse as process water during operations. At mine closure, collected seepage would be routed through the waste water treatment facility and discharged to the Clark Fork River. Seepage would continue to be treated until it met ambient groundwater quality without a mixing zone. If seepage continued to contain pollutants, then a discharge permit and mixing zone would continue to be required.

Tailings Surface Storage Methods. Two basic methods of storing tailings on the ground surface are being considered. The first is the more conventional method of storing slurried tailings in an impoundment behind a retaining embankment. The second method involves depositing the tailings on the ground as a paste, much like building a free-form concrete structure.

Various methods of tailings impoundment construction are reviewed in detail in Appendix E of the draft EIS. For the amount of tailings associated with the proposed action (100 million tons), only staged embankment construction was considered a viable impoundment construction method. This type of tailings retention structure uses the sand portion of the tailings as its primary construction material. This tailings sand is sequentially added to the embankment in stages to build the dam that retains the tailings. There are three general categories of staged embankments. They are named according to the horizontal direction the crest of the dam moves during its construction lifetime; 1) upstream, 2) downstream, and 3) centerline**.** In addition, there are hybrid styles of construction, such as the modified centerline, that combine construction methods to adapt them to specific sites (see **Figure 2-3**).

ASARCO presented a proposal to deposit tailings on the ground surface as a paste for Agency review and consideration as an alternate method of disposing tailings (Golder Associates 1996, Knight-Piesold 1997). This proposal was an outgrowth of investigating paste backfilling in the mine in response to public comments on the draft EIS. Paste deposition consists of dewatering the tailings to create a paste with a known consistency (20 percent water and 7-inch slump) along with a binder, if necessary, and placing the paste on the surface. More information about paste deposition can be found in the Alternative V description in this chapter.

The Agencies reviewed the various construction methods to address concerns about stability and amount of disturbed area. Each construction method has corresponding seepage and drainage collection systems.

Figure 2-3 Impoundment Construction Methods

Rail Loadout Facility Operation. Recent investigations into potential lead contamination at the Troy Mine loadout facility in Troy, Montana, have led to concern that a similar situation could develop at the Rock Creek rail loadout facility. To prevent possible lead contamination of the ground and surface waters, the Agencies and ASARCO determined that the rail loadout facility needed to completely contain the concentrate. All components of the concentrate storage and railcar loading process would be contained within an enclosed facility. The railcars would also be covered to minimize the risk of spills enroute to the smelter. Additionally, instead of trucking concentrate to the loadout facility, under Alternative V the concentrates would be slurried to the loadout facility in a buried pipeline and dewatered at the facility. Reclaimed water would be pumped to the mill for reuse.

Alternatives Considered in the Supplemental EIS

Four alternatives were carried forward for consideration in the draft EIS. One additional alternative is being considered in this supplemental EIS. The no-action alternative (Alternative I) and ASARCO's proposal (Alternative II) have been included in the supplemental EIS for comparison purposes and as required by MEPA (17.4.621(2), MCA). Brief descriptions of the alternatives follows:

Under Alternative I, the no-action alternative, the project would be denied or bought out by public agencies. The no-action alternative provides a baseline for estimating the effects of other alternatives.

Alternative II is ASARCO's proposed plan. ASARCO would construct, operate, monitor, and reclaim the Rock Creek Project as proposed in the plan of operation and application as well as its air quality permit application and MPDES permit application. The Agencies would issue the necessary permits and approvals.

Alternative III consists of Agency-initiated modifications to ASARCO's mine proposal (see the draft EIS for alternative description). The changes include:

- a different design for the tailings impoundment dam including agency technical panel review of the redesign;
- relocation of the intersection of Rock Creek Road (FDR No. 150) and Montana Highway 200;
- relocation of the rail siding to Miller Gulch;
- relocation of the wilderness ventilation adit;
- modified mine portal access;
- rerouting of the utility and road (primarily FDR No. 150) corridors; and
- relocating the water treatment facility away from proposed major wetland mitigation site.

Mitigations include:

- geochemical and acid-base account testing;
- rock mechanics studies;
- measures to protect scenic resources;
- changes in reclamation/revegetation plans;
- measures to reduce noise levels;
- additional grizzly bear mitigations;
- expanded monitoring for hydrology, soils and revegetation, fisheries/aquatics, and wildlife;
- a subsidence control and monitoring plan;
- an aquatics/fisheries mitigation plan; and
- amending the Forest Plan to change Management Area allocations.

Alternative IV includes the mitigations and modifications from Alternative III (see the draft EIS for alternative description). Additional modifications include:

- relocating mine adits and mill site, subsequently reducing utility and road corridor length.

Additional mitigations due to the mill site relocation include:

- site-specific changes in the reclamation/revegetation plan;
- a 300-foot stream buffer along the mill site;
- a visual buffer between the mill site and FDR No. 150; and
- changes to grizzly bear mitigation (replacement acreage changes).

Alternative V includes most of the mitigation and modifications from Alternative III and those from Alternative IV relating to the relocation of the mill site. Additional modifications include:

- deposition of tailings as a paste rather than as a slurry to reduce seepage to ground water, mitigate visual impacts, enhance site reclamation, and enhance stability;
- modification of the water treatment system to include semi-passive biotreatment and reverse osmosis system;

- enclosure of the rail loadout facility and use of covered railcars to minimize ground contamination and blowing of concentrate at the site and en route to smelter; and

- relocation of the evaluation adit support facilities site away from Rock Creek.

Additional mitigations developed in response to the modifications and responses to public comments on the draft EIS include:

- burial of pipelines to reduce vandalism and visual impacts and to enhance concurrent reclamation of the pipeline corridor;

- pumping of concentrate to the rail loadout to reduce truck traffic on FDR No. 150 to reduce impacts to harlequin ducks and grizzly bears;

- busing of mine workers and visitors from parking lot in lower Rock Creek area to reduce mine-related traffic on FDR No. 150 and reduce impacts to harlequin ducks;

- limited access to 150B from junction with FDR No. 150 to the paste production plant to reduce traffic immediately adjacent to Rock Creek where the 300 foot-buffer could not be established to reduce impacts to harlequin ducks;

- restricted timing for road construction/reconstruction on FDR No. 150 and 150B and hauling of waste rock to the paste facility site to avoid disturbance to harlequin ducks during the breeding and rearing season between May and August;

- development of a site-specific reclamation/revegetation plan in conjunction with the final design for the tailings paste deposit;

- development of new water management plans and MPDES permit application due to alternate tailings disposal method; and

- development of new wetland mitigation plan due to loss of a major mitigation site (borrow site #3 adjacent to Rock Creek would not be developed).

ASARCO has suggested some operational changes at the Agencies' alternative mill site to improve milling efficiency. This included relocating the mine adits and portals to line up with the milling facilities and replacing the secondary crusher with a semi-autogenous (SAG) mill. These changes have been incorporated into Alternative V.

PART II: ALTERNATIVES DESCRIPTION

Alternative I — No Action

Under this alternative, ASARCO would not develop the Rock Creek Project. The environmental, social, and economic conditions described in Chapter 3 would not be affected by the construction and operation of the project. Any existing exploration-related or baseline collection disturbances by ASARCO would be reclaimed in accordance with existing laws and permits.

The Forest Service currently does not have the authority to deny the project if the applicant demonstrates compliance with all applicable laws and regulations. National Forest System lands (NFS lands) outside wilderness are open to mineral entry under mining laws. NFS land within the wilderness are open to mineral development (generally subsurface) on lands claimed prior to December 31, 1983 and proven to be valid. Federal land policy (Minerals Policy Act of 1970) fosters and encourages the development of mineral resources in an environmentally sound manner, and ensures lands are reclaimed. DEQ may deny the application for the reasons set out in §82-4-351, MCA: (1) conflict with laws protecting air quality or water quality (Title 75, Ch.2, 5 and 6, MCA) or rules adopted pursuant to these laws; or (2) the reclamation plan does not provide an acceptable method for accomplishment of reclamation as required by the MMRA. In addition, DEQ interprets MEPA as supplementing the basis upon which an operating permit under MMRA may be conditioned or denied. The effect of this interpretation is that DEQ can deny or condition an operating permit under MMRA for environmental reasons in addition to those listed in §82-4-351, MCA. DEQ can deny or condition a permit in order to avoid or mitigate any significant environmental impacts identified in the EIS.

The following scenarios describe how the No-action Alternative might be implemented:

- If the Agencies determined that ASARCO could not comply with all applicable laws and regulations, DEQ could deny ASARCO's permit application and the Forest Service could refuse to approve the plan of operations.

  If DEQ’s decision resulted in litigation, the court would determine whether or not the project could comply with the environmental laws and regulations. If the court determined the project could not comply with the laws, then ASARCO would be prohibited from developing the mine as proposed, but it would not preclude ASARCO or a new applicant from submitting a new plan of operations/permit application. Any new application would then be required to undergo a new environmental impact evaluation. If the courts determined the project could comply with the laws, then DEQ could be required to approve the plan of operations with whatever court stipulations were mandated and the impacts would be similar to those described in Chapter 4 for the action alternative(s) that most closely resembled the court ordered alternative.

  If the Forest Service refused to approve the plan of operations, ASARCO could appeal the decision through the Forest Service and Department of Agriculture’s appeal process or challenge it in federal court. The resulting decision and impacts could be similar to that described for a DEQ denial above.

- The Forest Service does not have authority to acquire the ASARCO property through a condemnation action. However, Congress could concurrently give the Forest Service authority through special legislation to condemn the property, forcing sale of it to the United States, and appropriate money to pay for the purchase. Depending upon the authority used, any lands purchased by the U.S. usually have acquired status, meaning that the mineral estate is subject to leasing, not to mineral location.

- Another scenario is a willing buyer/willing seller approach. If ASARCO were willing to sell, and the United States willing and able to purchase the property, a "buyout" could be implemented. Subject to some restrictions, the Forest Service has the authority to purchase lands that meet Forest Plan and national objectives. However, Congress currently has not appropriated money for the Forest Service to purchase these lands. To assist in evaluating the options to implement the No-action Alternative, the Agencies have approached ASARCO to see if it would willingly sell the property to the United States, and at what price. ASARCO has stated the claims are not for sale.

  Under this scenario, as provided in the 1964 Wilderness Act, Congress would have to specifically authorize the acquisition of the wilderness portion of the lands, as well as appropriate the necessary money to purchase all of the lands. Depending on the authority used, any lands purchased by the United States usually have acquired status, which means that the mineral estate is subject to leasing, not to mineral location. However, the lands could be withdrawn from mineral location.

Regardless of the actual details of implementation of the No-action Alternative, the initial result would be the lack of mine development. Chapter 4 outlines the likely effects of the lack of mine development and assumes minerals have been withdrawn from future entry. If minerals were not withdrawn from future entry, mining could again be proposed at some future date. The effects would be evaluated at the time such a proposal was submitted.

Alternative II — ASARCO Project Description (Proposal)

Alternative II is ASARCO's project as proposed in the application and plan of operations submitted to the Department of State Lands (DSL) and the Forest Service. Important highlights of ASARCO's proposed exploration, operating, and reclamation plans are described below. For specific details, see ASARCO's exploration and operating permit applications and the draft EIS.

ASARCO proposes to construct a 10,000-ton-per-day mine and mill complex to extract copper and silver ore from a mineral deposit underlying a portion of the CMW, about 13 miles northeast of Noxon, in Sanders County, Montana. (See **Figures 1-1 and 2-4**.) ASARCO acquired title to the minerals by using the minerals patent process of the 1872 Mining Law. The project is similar in scope and operation to ASARCO's inactive Troy Mine in Lincoln County, Montana. ASARCO anticipates a 1-year period for constructing the evaluation adit in addition to a 3-year period for mine construction and development with limited ore production (see **Figure 2-5**). Full production would begin after that and is estimated to last for 30 years. The full production life would depend upon metal prices, engineering, and other factors that determine financial viability.

FIGURE 2-4 Alternative II

FIGURE 2-5 Mine Preproduction Development Schedule

Postmining reclamation is estimated to last 2 years (after the tailings impoundment surface dried enough for reclamation activities).

The proposed permit boundary would encompass 2,422 acres, of which 583 acres are proposed to be disturbed and 1,839 would remain undisturbed (see **Table 2-2**). Land encompassed by the proposed permit boundary is 35 percent privately held and 65 percent NFS lands (see **Figure 2-6**).

Evaluation Adit

- Evaluation adit driven 6,592 feet at a 10 percent decline.
- 59,000 tons of waste rock and 119,000 tons of ore would be excavated. Waste rock would be end dumped near the adit portal and ore could be stockpiled for processing later when mill was operational.
- Adit would function as a ventilation adit and secondary escapeway during mine production.
- An estimated 8.3 acres disturbed at the adit.
- Support facilities site located on ASARCO lands in Section 22 near 3-mile marker on FDR No. 150. (See **Figure 2-7**).

Mine Plan

- Two 9,000-foot parallel adits would be driven at a grade of +12.7 percent to the underground crusher.
- 600,000 tons of waste rock would be produced during mine adit construction. Some would be used for the mill site; the remainder would be placed into a hillside waste rock dump. Waste rock generated during mining would remain underground.
- An additional ventilation adit into the CMW may be required about year 20.
- Conventional underground mining methods of drilling, blasting, rock bolting and mucking would be used.
- Mining would use room and pillar or pillar-slot design (see **figures 2-8 and 2-9**). Horizontal pillars would be used when mining thick ore zones (see **Figure 2-10**).
- Minimum 100 foot buffer zones would be left between underground workings and surface.

Surface Disturbance

- The proposed project would disturb 583 acres.

TABLE 2-2
Surface Disturbance Acreage (net acres impacted)[1]

Disturbance Type	Alt II	Alt III	Alt IV	Alt V
Tailings Impoundment/Deposit & Associated Components	**389**	**404**	**404**	**368**
Dam faces and impoundment surface	324.0	324.0	324.0	324
Borrow areas 2 and 3	27.2	27.2	27.2	0
Roads	6.6	6.8	6.8	7.9
Soil stockpiles sites	21.7	36.7	36.7	18
Water control structures	9.2	9.2	9.2	9.2
Pump station	0.2	0.2	0.2	0.2
Tailings Paste Plant	N/A	N/A	N/A	9.0
Transportation Corridor	**96**	**90**	**70**	**64**
Access road	36.2	43.8	36.0	35.9
Tailings line corridor	13.4	6.9	2.4	2.2
Powerline	44.3	37.9	29.8	24.2
Emergency impoundments	2.0	2.0	2.0	2.0
Fresh water well	0.2	0.2	0.2	0.2
Mill Facilities	**49**	**56**	**48**	**31**
Fenced area	40.0	40.0	47.0	30.4
New public road	1.3	8.0	0	0
Fresh water well	0.1	0.1	0.1	0.1
Water control structures	1.5	1.5	0.7	0.7
Soil stockpile sites	6.0	6.0	**	**
Water Treatment Facility	**10**	**10**	**10**	**10**
Mine	**30**	**38**	**0**	**0**
Access road	15.2	16.4	**	**
Waste rock dump	10.0	17.0	0	0
Portal area	1.0	1.0	**	**
Powerline corridor	0.8	0.8	**	**
Conveyor corridor	1.2	1.2	**	**
Air intake adit	0.1	0.02	0.02	0.02
Water control structures	0.1	0.1	0.1	0.1
Soil stockpile sites	1.5	1.5	**	**
Evaluation adit	**10**	**10**	**10**	**8**
Mine entry patio and waste rock dump	8.3	8.3	8.3	8.3
Support facilities	1.3	1.3	1.3	0
Total Acres Disturbed	**584**	**609**	**542**	**481**

** Covered under Mill Facilities (part of "fenced area"); N/A = not applicable
[1] Total disturbance for each mine facility has been rounded to the nearest whole number.

Figure 2-6 Landowner Ship and Permit Boundary

FIGURE 2-7 Exploration Adit and Support Facilities

FIGURE 2-8 Room and Pillar Method

FIGURE 2-9 Slot Pillar Method

FIGURE 2-10 Thick Ore Zone Room-and-Pillar Method

- The Forest Plan would be amended so that management allocations on 201 acres would be consistent with the intended use.

Ore Production Schedule

- Mine would produce 10,000 tons of ore per day or 3.5 million tons per year.
- Project has an anticipated production life of 30 years.

Ore Processing and Shipping

- Ore-processing facilities would consist of underground primary crusher, and above-ground secondary crushing plant, concentrator, tailings thickener, drainage sumps, pumps, and slurry and water pipelines (see **Figure 2-11**).
- Mine office, changing rooms and showers, and shop warehouse also located at mill site.
- Chemical reagents added to flotation process to separate ore concentrate (see **Appendix F**).
- The mill would produce about 51,000 tons of concentrate per year.
- Concentrate would be hauled in trucks 13 miles to the Hereford rail loadout facility 7 days a week.
- Concentrate would be loaded onto rail cars six to eight times every 24 hours. Loaded rail cars would be removed approximately three times a week according to Montana Rail Link's schedule.

Tailings Impoundment

- Tailings slurry would be transported from thickener at mill to impoundment via twin 10-inch urethane-lined, steel pipelines.
- Impoundment located northwest of the confluence of Rock Creek and the Clark Fork River and northeast of Montana Highway 200 in Section 28, T26N, R32W, primarily on ASARCO fee lands (see **Figure 2-12**).
- Sandy component of the tailings would be used to construct upstream embankment and sandy beach area (needed for embankment seepage control); slimes or fines would be stored behind the embankment (see **Figure 2-3**).

Tailings Impoundment Seepage

- Seepage would be captured and routed away from embankment; collected water would be pumped back onto the impoundment.

FIGURE 2-11 Proposed Mill Site Layout for Alternative II

- Seepage through the impoundment would be captured through a system of underdrains, perimeter trench drains and ground water pump-back wells (see **figures 2-12** and **2-13**).

- Monitoring wells would monitor seepage collection system performance.

Storm Water Control

- Diversion ditches would route storm water upslope of all mine facilities around them to avoid mingling with on-site storm water.

- On-Site storm water would be collected and incorporated into the facility's operation: evaluation adit storm water would be used for driving the adit, mill-site storm water would be incorporated into the mill circuit process, and storm water collected on the impoundment and at related facilities around the impoundment would be stored in the impoundment.

Water Use and Management

Evaluation Adit Operation

- 30 gpm of water would be needed for drilling adit; water would be trucked up from make-up water well at first, then adit waste water and collected storm water would be used.

- Excess mine water would be routed to temporary waste water treatment facility at support facility site prior to discharge.

- Potable water would be trucked to evaluation adit site and obtained from wells at the support facility site.

- Sewage would be handled through septic tanks and leach fields, or holding tanks.

Mine Operation

- The Mine would require 3,131 gpm of process water at full production (see **Table 2-3),**

- Makeup water could come from: mine adit water, a make-up water well near the Clark Fork River, waste water from sewage treatment plant, mill site storm water runoff, thickener overflow, and reclaimed water from the tailings impoundment.

- Mine water may be stored in workings (see **Figure 2-14**) to help regulate water flow through the waste water treatment facility.

- An activated sludge sewage treatment facility would be located at the mill site.

- Passive biotreatment cells and ion exchange would provide mine waste water treatment after settling and filtration.

FIGURE 2-12 Proposed Tailings Impoundment

FIGURE 2-13 Conceptual Layout for Impoundment Seepage Collection System

TABLE 2-3
Water Balance Summary - Average Yearly Project Flows

	Line #	1	2	3	4	5	6	7	8	9	10	11	12	13	18	23	28	29	30
Adit Balance																			
Inflow																			
Adit Inflow	42	4	132	407	586	632	695	712	777	843	909	974	1040	1106	1434	1763	2091	2091	2091
Ore Water	66	0	0	0	0	0	20	30	30	30	30	30	30	30	30	30	30	0	0
Outflow																			
Impoundment Storage	44	0	0	0	0	61	38	131	145	144	158	172	160	171	199	216	184	0	0
To Biotreatment	43	4	132	407	586	571	643	556	611	676	728	772	816	851	1069	1355	1615	1796	1796
Mill Reclaim Pond	45	0	0	0	0	0	13	25	21	20	11	2	13	11	7	15	74	0	0
Mine Workings Storage	46	0	0	0	0	0	0	0	0	3	13	29	51	74	160	176	218	296	296
Ore Water	66	0	0	0	0	0	20	30	30	30	30	30	30	30	30	30	30	0	0
	SUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mill Balance																			
Inflow																			
Water in Ore	66	0	0	0	0	0	20	30	30	30	30	30	30	30	30	30	30	0	0
From Mill Reclaim Pond	70	0	0	0	0	0	2042	3101	3101	3101	3101	3101	3101	3101	3101	3101	3101	0	0
Outflow																			
Water in Concentrate	67	0	0	0	0	0	2	3	3	3	3	3	3	3	3	3	3	0	0
Tailings	68	0	0	0	0	0	2059	3128	3128	3128	3128	3128	3128	3128	3128	3128	3128	0	0
	SUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thickener Balance																			
Inflow																			
Tailings	92	0	0	0	0	0	2059	3128	3128	3128	3128	3128	3128	3128	3128	3128	3128	0	0
Waste water	93	0	0	0	0	0	12	15	15	15	15	15	15	15	15	15	15	15	15
Plant Runoff	94	0	0	0	0	0	37	47	47	47	47	47	47	47	47	47	47	47	47
Outflow																			
Tailings Slurry	95	0	0	0	0	0	539	819	819	819	819	819	819	819	819	819	819	0	0
Thickener Reclaim	97	0	0	0	0	0	1570	2372	2372	2372	2372	2372	2372	2372	2372	2372	2372	0	0
Overflow to Impoundment	116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	62
	SUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mill Reclaim Pond Balance																			
Inflow																			
Adit inflow	105	0	0	0	0	0	13	25	21	20	11	2	13	11	7	15	74	0	0
Thickener Reclaim	97	0	0	0	0	0	1570	2372	2372	2372	2372	2372	2372	2372	2372	2372	2372	0	0
Tailings Reclaim	104	0	0	0	0	0	458	705	708	709	719	728	716	719	723	714	655	0	0
Outflow																			
To Mill	102	0	0	0	0	0	2042	3101	3101	3101	3101	3101	3101	3101	3101	3101	3101	0	0
	SUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2-3
Water Balance Summary - Average Yearly Project Flows (Cont'd)

	Line #	1	2	3	4	5	6	7	8	9	10	11	12	13	18	23	28	29	30
Impoundment Balance																			
Inflow																			
Post-production thickener overflow	116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62	62
Excess evaporation	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	160	160
From Mine for Storage	111	0	0	0	0	51	38	131	145	144	158	172	160	171	199	216	184	0	0
Tailings Slurry	110	0	0	0	0	0	539	819	819	819	819	819	819	819	819	819	819	0	0
Climate Inflow	109	0	0	0	0	44	103	136	169	202	235	236	237	237	237	209	186	186	186
Outflow																			
Change in Storage	118-108	0	0	0	0	59	-52	-1	1	1	3	3	-2	2	6	3	1	-24	0
Evap and Dust Sup	112	0	0	0	0	123	138	174	215	245	281	287	293	298	317	318	329	329	329
Tailings Reclaim	113	0	0	0	0	0	458	705	708	709	719	728	716	719	723	714	655	0	0
Water retained in Tails	114	0	0	0	0	0	223	339	339	339	339	339	339	339	339	339	339	0	0
Net Seepage*	115	0	0	0	0	-77	-131	-131	-131	-131	-131	-131	-131	-131	-131	-131	-131	-131	-131
Excess to Passive Biotreatment	134	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	0	234	209
System	**SUM**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mine Workings																			
Inflow																			
Inflow to Storage	122	0	0	0	0	0	0	0	0	3	13	29	51	74	160	176	218	296	296
Outflow from Storage	124	0	0	0	0	0	0	0	0	3	13	29	51	74	74	192	263	111	293
Outflow																			
Change in Storage	126-128	0	0	0	0	0	0	0	-0	0	0	0	0	0	87	-16	-45	184	3
	SUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Treatment System																			
Treatment Inflow		4	132	407	586	571	687	555	611	680	740	802	867	925	1144	1547	1878	2141	2298

Note: All values are in gallons per minute (gpm).
Line # = Line number from water balance model, see Water Management Plan (ASARCO 1995).
* = A worst case seepage rate of 241 gpm was used for hydrogeologic analyses.

FIGURE 2-14 Underground Water Storage Schematics

- A temporary waste water system would be located at the support facilities site during evaluation adit construction.

Transportation

- Access to the evaluation adit would be from Montana Highway 200 to FDR nos. 150 and 2741 to a short spur road to the adit.
- Access to the mine would be 6.5 miles up FDR No. 150 from Montana Highway 200.
- FDR No. 150 would be rerouted to the south side of Rock Creek and around the mill site (see **figures 2-15 and 2-16**).
- One new bridge would be built and two bridges reconstructed on FDR No. 150.
- An 8,800-foot long gravel road would be built from the mill site to the mine portal (see **Figure 2-16**).

Utilities

- Power would be provided by diesel generators at the evaluation site and from an existing powerline at the support facilities site.
- A new 230 kV powerline would provide service to the mill site.
- ASARCO anticipates an estimated annual power consumption of 95,000,000 kW-hours with a peak demand of 13,300 kW during mine production.
- No power provider has been selected.

Erosion and Sediment Control

- Mechanical measures would be used to minimize fugitive dust.
- Site grading would be designed and implemented to reduce erosion potential.
- Soil handling techniques would be used to enhance stability.
- Hydrologic systems would be installed to control runoff and sedimentation.
- Revegetation practices would be used to provide stabilizing cover.

FIGURE 2-15 Proposed and Alternate Relocations of FDR No. 150

FIGURE 2-16 Alternate Mine Access Roads

Employment

- Evaluation adit construction would take 1 year and employ 20 to 55 workers.
- Mine construction and start up operations would take 3 years and employ 44 to 240 ASARCO employees and 248 to 345 contract workers.
- Mine operations would take 30 years and employ 260 to 355 ASARCO employees.
- Reclamation activities would require a minimum of 2 years and employ 35 workers.

Adit Closure

- The evaluation adit would be sealed to prevent human access after mine operations ceased (ASARCO Incorporated 1992).
- ASARCO's mine permit application is not clear as to whether or not mine adits would be sealed or left free draining; but probably all mine adits and the ventilation adit would be plugged.

Reclamation

- Short-term objectives are to stabilize disturbed areas and prevent air and water pollution.
- Long-term objective is to establish a post operational environment compatible with existing land uses and consistent with the Forest Plan.
- Evaluation adit and support facilities sites would be reclaimed to approximate original contours after the mill was operational.
- Impoundment face would be reclaimed concurrently with 3:1 slopes (see **Figure 2-17**). The top would be reclaimed after it had dried sufficiently to support grading equipment.
- All buildings, equipment, and infrastructures would be removed from mill site when mine was closed. Mill site reclaimed to a sloping bench (see **Figure 2-18**).
- Ground water pump-back system would not be shut down and removed until seepage and ground water beneath the impoundment met Montana water quality standards and limits specified in the MPDES permit.
- The waste water treatment plant would remain operational until mine water and reclaim water from the impoundment (if routed to the plant) met Montana water quality standards.
- Evaluation adit and mine adits would be plugged allowing mine water to fill underground workings after closure.
- Soil salvage and replacement would be as shown on **tables 2-4** and **2-5**.

FIGURE 2-17 Alternative II Postmining Topography of the Tailings Impoundment

FIGURE 2-18 Alternative II Postmining Topography of the Mill Site

TABLE 2-4
Soils Salvage Summary - Alternative II

Disturbance	Soil salvage area (acres)[1]	Salvageable topsoil (yd^3)[2]	Stockpile number
Evaluation Adit			
-Portal area\first lift -	7.7	2,369	evaluation adit site
-Portal area\second lift	2.0	6,388	evaluation adit site
-Subtotal for portal area	7.7	8,757	
-Support facilities	1.3	4,195	adjacent to parking lot
Tailings impoundment & associated components			
- Dam faces & impoundment surface	324	378,770	1, 2
- Borrow areas 2 & 3	27.2	48,642	2
- Roads (access, haul)	5.4	9,290	adjacent to road
- Water control structures	9.2	17,141	adjacent to structure
- Pump station	0.2	323	2
Transportation corridor			
- Access road	16.9	32,024	adjacent to road
- Tailings line corridor	10.2	19,560	adjacent to corridor
- Emergency impoundments	2.0	4,302	adjacent to impoundment
- Fresh water well	0.2	485	adjacent to well
Water treatment facility	10.0	32,269[3]	2
Mill facilities			
- Fenced area	40.0	91,840	3, 4
- New public road	2.8	7,341	4
- Fresh water well	0.1	81	adjacent to well
- Water control	1.5	929	adjacent to structure
Mine			
- Access road	0	0	
- Waste rock dump	0	0	
- Portal area	0	0	
- Water control structures	0	0	
Total	**458.7**	**664,706**	

Source: ASARCO, Incorporated 1986-1993.

Note: [1]Total soil salvage acreage does not equal total disturbance acreage in **Table 2-1** because soil would not be salvaged from the mine, soil stockpile sites, powerline and conveyor corridors on slopes that exceeded 2:1, or areas where soil has already been removed (such as existing roads). Soil stockpiles are shown on **Figures 2-4, 2-7, 2-11 and 2-13.**

[2]Volumes represent in-place measurements; yd^3 = cubic yards.

[3]Volumes estimated by the Agencies.

TABLE 2-5
Alternative II Soil Replacement Depths

Mine Facility	Replace Soil Depth (inches)
Evaluation Adit:	
Portal and waste rock dump top	12
50% waste rock dump face	13
50% waste rock dump face	0
Support Facilities Site	at least 12 inches
Mill site, waste rock dump top, and mine portal	11.4
Transportation Corridor	14.3
Tailings Impoundment	9.5

- Seeding mix would consist of native and non-native grasses and forbs along with an annual grain for achieving rapid cover. Shrubs would be seeded on all sites except the evaluation adit, and transportation and utility corridors.

- Trees would be planted on slopes that do not exceed 3:1 in the impoundment area, the support facilities site, the mill site, mine waste rock dump top, and the access road to the mine waste rock dump.

Monitoring and Mitigation Plans

- Air quality monitoring plan
- Soils and erosion monitoring plan
- Revegetation monitoring plan that would include inspection, and evaluation of revegetation
- Fish and wildlife mitigation plan
- Threatened and endangered species mitigation plan
- Water monitoring plan
- Rock mechanics monitoring plan
- Tailings impoundment and tailings slurry line construction monitoring plan
- Hard Rock Mining Impact Plan (see description under Alternative V)

- Wetlands mitigation plan (see **Figure 2-19 and Tables 2-6** and **2-7**)

Alternative III — Proposed Project with Modifications and Mitigations

Alternative III incorporates modifications and mitigating measures proposed by the Agencies to reduce or eliminate undesirable environmental impacts (see **Figure 2-20**). These measures are in addition to or instead of the mitigations proposed by ASARCO. Proposed modifications were developed in response to the significant issues identified during the scoping process. Alternative III is described and analyzed in the draft EIS and is not included in the supplemental EIS. However, due to changes in analyses based on either new data or analysis methods, impacts to Forest Plan, Aquatics/Fisheries, Biodiversity, and Threatened or Endangered Species are included for Alternative III in Chapter 4.

Alternative IV — Modified Project

Alternative IV incorporates an alternate mill site location along with modifications and mitigating measures proposed by the Agencies in Alternative III to further reduce or eliminate undesirable environmental impacts (see **Figure 2-21**). These measures are in addition to or instead of the mitigations proposed by ASARCO. Proposed modifications were developed in response to the significant issues identified during the scoping process. Alternative IV is described and analyzed in the draft EIS and is not included in the supplemental EIS. However, due to changes in analyses based on either new data or analysis methods, impacts to Forest Plan, Aquatics/Fisheries, Biodiversity, and Threatened or Endangered Species are included for Alternative IV in Chapter 4.

Alternative V — Rock Creek Project with Tailings Paste Deposition and Alternate Water Treatment (Preferred Alternative)

The major modifications distinguishing this alternative from Alternative IV as described in the draft EIS are the deposition of tailings as a paste, an alternate water treatment system, an enclosed rail loadout facility, and relocation of the evaluation adit support facilities (see **Figure 2-22**). **Table 2-8** lists the significant issues pertinent to this project and indicates which of the following sections addresses mitigating measures for those issues. Chapter 4 contains a more detailed discussion of how the mitigating measures would reduce or eliminate environmental impacts.

In addition, to the major modification mentioned above, Alternative V includes the following applicable modifications, mitigations, and monitoring plans from Alternatives III and/or IV, described in the draft EIS:

Modifications:

- Alternate mill and mine portal location at confluence of east and west forks of Rock Creek (Alternative IV) and subsequently shorter access road and utility corridor

- Alternate rail loadout location near Miller Gulch (Alternative III)

TABLE 2-6
Affected Acreage of Wetlands and Waters of the U.S by Mining Alternatives

	Affected Acreage (Direct and Indirect)		
Mining Alternative	**Wetlands**	**Waters of the U.S.**	**Total Acres**
Alternative II - ASARCO Proposed Project	8.1	1.5	9.6
Alternative III - Proposed Project with modifications and mitigations	6.2	1.5	7.7
Alternative IV - Modified Rock Creek Project with mitigations	6.2	0.4	6.6
Alternative V- Tailings Paste Deposition	6.2	0.4	6.6

Source: ASARCO, Incorporated 1993 and 1997 (March 26, 1997, Preliminary Designs for Wetlands Mitigation, Alternative 5)

TABLE 2-7
Proposed Acreage and Schedule for Created Wetlands and Reconstructed Waters of the U.S. - Alternative II

WETLAND MITIGATION SITES	CREATED ACREAGE		SCHEDULE
	WETLANDS	WATERS OF THE U.S.	PROJECT YEAR
ASARCO mill site area		1.5	30
Borrow area 3	7.5		4 - 5
Access road sites	1.8		1
Miller Gulch sites	1.2		1 - 2
Rock Creek sites	1.8		1
TOTAL WETLAND MITIGATION	**12.3**	**1.5**	1 - 30

FIGURE 2-19 Waters of the U.S. Wetlands Mitigation Sites

FIGURE 2-20: ALTERNATIVE III

FIGURE 2-21 Alternative IV

FIGURE 2-22: ALTERNATIVE V

TABLE 2-8
Alternative V Modifications and Mitigations

Significant Issues	Categories							
	Mine Plan & Ore Processing	Tailings Disposal	Water Use & Manage-ment	Transpor-tation	Utilities	Employment	Reclamation	Monitoring & Mitigation Plans
Surface & Ground Water Quality		x	x	x	x		x	x
Fish, Wildlife, and T&E Species	x	x	x	x	x	x	x	x
Impoundment/Paste Facility Stability		x						
Socioeconomics	x							
Old Growth Ecosystem	x							
Waters of the U.S. and Wetlands	x	x						x
Public Access/Traffic Safety	x			x				
Aesthetic Qualities	x	x			x		x	

- Alternate location for wilderness ventilation adit (Alternative III)
- Combined utility and road corridor (Alternative III)
- Relocation and reconstruction of FDR No. 150 (Alternative III)

Mitigations:

- Subsidence control and monitoring plan (Alternative III)
- Rock mechanics and hydrogeologic sampling, testing and monitoring program to include an acid-base testing program (Alternative (III)
- Visual and sound mitigations for the mill site (alternatives III and IV), and ventilation and evaluation adits (Alternative III)
- Technical panel review of final tailings impoundment design (paste facility under Alternative V) (Alternatives III and IV)
- Development of a transportation management plan (Alternative III)
- Visual mitigations for the utility corridor and tailings impoundment site (paste facility site under Alternative V) (Alternative III)
- Revised grading and revegetation plans for the mill site to mitigate visual impacts (Alternative IV)
- Deeper soil salvage (24 to 36 inches) and replacement depths (average of 24 inches) to facilitate revegetation (Alternative III)

- More detailed long-term reclamation monitoring plan than Alternative II (Alternative III)
- More detailed aquatics/fisheries, wildlife, threatened and endangered species monitoring and mitigation plans than under Alternative II, including a sediment source reduction plan (Alternative III)
- A comprehensive, long-term water monitoring plan which includes monitoring lake levels at Cliff and Copper lakes to be coordinated with subsidence control and monitoring plan and fisheries/aquatics monitoring plans (Alternative III)
- An alert level and contingency/corrective action plan for each monitoring plan (Alternative III)
- Maintenance and possible long-term post-closure waste water treatment (Alternative III)

Evaluation Adit

Evaluation activities would remain essentially the same as described for Alternative II in the draft EIS and summarized above in this chapter. However, the support facilities site has been relocated to a site within the paste facility footprint (see **Figure 2-22**). The power source for the adit has been changed to propane generators and is discussed under ***Utilities***. Changes to waste water treatment are discussed under ***Water Use and Management***.

Mine Plan

The mine plan would remain the same as described for Alternatives II through IV in the draft EIS. The mill site would be located at the confluence of the East and West forks of Rock Creek, as described for Alternative IV in the draft EIS. However, the mine portal would be moved to the west side of FDR No. 150 just north of the coarse ore storage. This lines the adits up with the mill facilities and eliminates two transfer points on the ore conveyor belt system. There would be no mine facilities on the east side of FDR No. 150 at the confluence mill site other than storm water control features. Some of the waste rock from driving the mine adits would be used for mill pad construction, road graveling, and paste facility construction. Hauling of waste rock from the adits to the tailings paste facility site would be restricted to mid-August through May as a mitigation to impacts on harlequin ducks.

There would be a minimum 100-foot vegetative buffer between FDR No. 150 and mine/mill facilities including the relocated mine portal for visual screening. There also would be a 300-foot buffer between the mill and either fork of Rock Creek.

Reduced-emission diesel engines would be used in place of standard diesel engines underground. Electric underground ore trucks would also be used. These modifications would reduce concentrations of NO_2, SO_2, and CO released to the atmosphere and underground workings.

Surface Disturbance

A total of about 481 acres would be disturbed within the permit area under Alternative V (see **Table 2-2**). The Forest Plan would be amended so that management allocations on 147 acres would be consistent with the intended use.

Ore Production Schedule

The development schedule has been lengthened because of the additional time needed to develop the longer adit.

The ore production schedule has been adjusted based on a more conservative recovery estimate of 65 percent and a revised amount of ore to 136,000,000 tons (see **Table 2-9**).

After limited ore production during early mine start-up there would be approximately 28 years of remaining production. The schedule is summarized below. This schedule could be affected by unforeseen delays related to permitting, design approvals, development or construction delays or accelerations, financial considerations, actual mining conditions and ore recoveries, and metal market conditions. An earliest estimated start date based on the EIS development schedule and possible timing of agency decisions would be no sooner than June 1999, however, actual project construction would be determined by ASARCO based on market conditions and other business considerations.

TABLE 2-9
Estimated Project Development Schedule

Project[1] Year 1	Evaluation Adit
Project Years 2 and 3	Mine Development[2]
Project Years 4 through 5.5	Mine Development[2]/Surface Facilities Construction[3]
Project Years 5.5 through 6	Start-up/Limited Production
Project Years 7 through 33	Production
Project Years 34 through 35	Reclamation

Notes:
1 Project year goes from beginning to end of that year. That is, project year 1 goes from 0 to end of year 1.
2 Waste rock would be hauled seasonally during mine development (years 2 through 6).
3 Includes construction of mill site, waste water treatment plant, paste plant and utilities corridor.

Ore Processing and Shipment

The ore-processing facility or mill would remain generally the same as is described for the proposed action, Alternative II, but located at the confluence of the east and west forks of Rock Creek as described for Alternative IV (described in the draft EIS). The primary difference from the other action alternatives is that there would be no tailings thickener facility at the mill site due to the change in tailings disposal (see Paste Deposition of Tailings below). The thickener would not be necessary as the tailings would be dewatered at the paste production plant adjacent to the tailings paste facility. However, the emergency dump pond and the storm water pond would be enlarged to provide additional water storage (see **Figure 2-23**).

ASARCO modified the milling operation to reduce particulate emissions under Alternative V. The surface dry milling operation or secondary crushing would be replaced with a semi-autogeneous (SAG) mill, a fully wet milling operation. Concentrate would be sent from the mill to the rail loadout facility as a slurry in a 3-inch HDPE-lined steel pipe with leak detection sensors and buried in the same corridor as the tailings and water pipelines. The rail-loadout process including concentrate de-watering, drying, filtering, and storage and railcar loading would take place within an enclosed building. Covered railcars would eliminate the use of a tackifier that would have been needed to minimize dust generation during transport to the smelter. Approximately 13 railcars of concentrate per week would be removed from the site. Reclaimed concentrate water would be piped to the paste plant and then to the mill for reuse.

Paste Deposition of Tailings

Tailings Transport. Tailings would be transported 4.1 miles from the mill to the paste plant as a slurry (30 percent tailings, 70 percent water) in a 16- to 24-inch, urethane-lined, steel pipeline (a double-walled pipeline) with leakage detection devices. This pipeline along with the 15- to 18-inch return process water line, which would also be used as the make-up water line, and the concentrate pipeline would be buried 24 inches deep (see **Figure 2-24**). Burying the pipelines will provide better protection from vandalism, eliminate the visible presence of the pipelines, and facilitate concurrent reclamation in the pipeline corridor along most of the route between the mill and the paste plant. The pipelines would be visible at the three above ground crossings of Rock Creek, West Fork Rock Creek, and Engle Creek. All lines would be encased in a larger steel pipe at creek crossings adjacent to or near bridge crossings to guard against the unlikely event of a leak or rupture.

Paste Production. In general, the tailings would be delivered to the paste plant and dewatered to make a paste with a known proportion of water (approximately 20 percent by weight). This paste would be applied to the ground surface after sediment and erosion control features are in place and soil has been salvaged.

The paste plant building, approximately 80-feet by 80-feet by 110-feet high, would be located on the hillside adjacent to the tailings paste facility site. The building would be built into the hillside and painted to help reduce its visual impact. Trees and vegetation surrounding the paste plant would be retained or planted to help visually blend the plant site with adjacent hillsides. ASARCO would conduct a site study verified by a visit with the Agencies prior to final siting of the plant and access road to select a location that would reduce plant visibility and avoid harlequin duck habitat to the extent possible.

FIGURE 2-23 Storm Water Diversion and Collection Plan for Mill Area

FIGURE 2-24: PIPELINE CORRIDOR DRAWING

The paste plant would be designed to receive, dewater, mix, and pump 10,000 tons of tailings per day, 365 days per year. The paste process schematic is shown in **figures 2-25 and 2-26**. The tailings slurry would be deposited into a tailings surge tank and then fed into two cyclone/separators. The cyclone underflow, composed of the coarser tailings, would be discharged into an agitated storage tank (25-foot-diameter by 50-foot-high) and could be discharged at a rate of 50 tons per hour (tph). The overflow, composed of primarily finer tailings, would be fed through a distributor box into one or more of the four 32-foot-diameter by 60-foot-high dewatering tanks. The tailings would be discharged from each tank at a rate of 67 tph. Maximum discharge rate could reach 90 tph to allow for maintenance of one tank while continuing paste production in the other three tanks.

Process water for paste production would come from the water discharged from the dewatering tanks. Process water would be stored in a 30,000-gallon tank; excess water would be pumped back to the mill for reuse or discharged from the mill to the waste water treatment facility for disposal.

The full plant tailings paste would be produced by combining the fine tailings paste from the dewatering tanks, the coarser tailings in the agitated storage tank, and additional process water as needed. Supplemental material such as a binder (Portland cement, fly ash, or slag cement) or seed and/or fertilizer to facilitate reclamation may be added as needed. Each dewatering tank would have a separate mixer capable of handling the maximum discharge from the dewatering tank plus the coarse material from the storage tank. The paste production would be monitored and regulated so that the resultant paste would have the consistency of a 7-inch slump. Positive displacement pumps would transport the paste via a high-pressure pipeline to the disposal location at the tailings paste facility.

The dewatering tanks would be designed to allow for continuous feed of tailings and production of paste even when one tank was off line for maintenance or repairs. The surge capacity of the dewatering tanks and the coarse tailings agitated storage tank would allow the paste production system to be shut down for 7 hours without stopping the tailings slurry feed from the mill or before using a tailings slurry feed containment site adjacent to the plant. In addition, each mixer has a surge capacity of 15 tons or approximately 10 minutes of down time for one mixer/pump pair without shutting down the paste production process.

A 7-acre contingency tailings slurry feed containment site would be near the paste production plant to contain approximately 6 days of tailings production should the paste production plant be totally disabled or in the event of a major failure beyond the control of the plant design (see **Figure 2-22**). This facility would be designed using traditional slurry impoundment design methods with a dam or embankment and would be lined with low permeability native materials (clay-type soils) to control seepage. The tailings stored in the containment pond would be dredged from the pond and reintroduced into the plant for disposal as a paste after the plant resumed operation. A paste plant shutdown of more than 6 days would result in the suspension of milling.

Tailings Paste Deposition. The location of the paste plant was selected to utilize a hillside location adjacent to the paste facility for convenient tailings materials handling and disposal. The paste plant design provides operational flexibility and avoids duplication in pump transport. Positive displacement pumps with a combined design capacity of approximately 680 dry tph would be used in an arrangement that would allow one pump to be shut down for either preventative or unscheduled maintenance. The paste would be pumped to the paste delivery system.

FIGURE 2-25 Paste Process Schematic

FIGURE 2-26: PASTE PROCESS SCHEMATIC

There are two primary paste deposition options for Alternative V and one combined paste deposition option. These options are named according to the direction in which the paste is deposited and the landform is built (see **Figure 2-27**, **2-28**, and **2-29**). These options are termed Bottom-Up option (Alternative V-a), Top-Down option (Alternative V-b), and Combined option (Alternative V-c).

The Bottom-Up option would initially involve spigotting paste from the lower elevations and moving the spigot point upslope. The Top-Down option would result in deposition of the paste by spigotting the paste from the upper-most slopes and moving the spigot point towards the highway; the deposit would gradually progress to the southern most portion of the deposit site. Under the Combined option the direction of paste deposit and spigot location would depend on the method being used at the time as described for the Bottom-Up and Top-Down options. The combined option would be used on a seasonal basis each year or alternate between a number of years with each of the first two options. The tailings paste facility would encompass approximately 305 acres for the paste facility and another 20 acres for associated features, such as soil stockpiles, under all options but acreage would vary slightly based on the final approved design.

A series of toe buttresses would be required for all options to assist in containing the paste on the downslope sides, improving slope stability, and retaining sediment eroding off the slopes. Under these conceptual designs, the buttresses would reach an ultimate height of approximately 80 feet (elevation of 2440 feet), but the actual height would depend upon engineering behavior of foundation soils to be analyzed in more detail in the final design. The toe buttresses would be located in approximately the same location as the starter-dams for the tailings impoundment designs in alternatives II through IV. The buttresses would be built during initial stages of mine development as rock was salvaged from within the deposit footprint or became available during adit construction. The buttresses would consist predominantly of rockfill totaling approximately 1,360,000 cubic yards. The rockfill could be obtained from rock outcrops within the deposit site, borrow areas within the deposit site, and waste rock produced from mine adit development (see **Table 2-10** for preliminary estimates of materials obtained from these sources). Waste rock from the adits would be hauled to the tailings paste facility site and used immediately for buttress construction to avoid rehandling this material or the need for a waste rock dump at the mill site. The waste rock could only be hauled between August 1st and March 31 to minimize impacts to harlequin ducks.

TABLE 2-10
Preliminary Volumes of Paste Facility Toe-Buttress Waste Rock Requirements

Source	Quantity (Cubic Yards)
Rock Outcrops	480,000
Borrow Areas	130,000
Mine Waste	750,000
Total	**1,360,000**

FIGURE 2-27: TAILINGS PASTE DISPOSAL SITE - BOTTOM-UP OPTION

FIGURE 2-28: TAILINGS PASTE DISPOSAL SITE - TOP-DOWN OPTION

FIGURE 2-29: PASTE DEPOSITION OPTIONS

The paste pipeline would be located either on the crest of the toe buttress for the Bottom-Up option or along the upper end of the deposition site for the Top-Down option. The location of the spigot or spigots for the Combined option would depend upon the method(s) being used at the time. A low load-bearing crawler crane would be used to position the pipe and spigotting would commence. Once a layer or a lift of paste had been completed, the crane, pipes, and spigot would be relocated further down the row onto the oldest portion of the previous paste layer, or to a new row if the previous one had been completed. A new layer of paste would then be spigotted onto the previous layer(s). There may be some delay in relocating the crane when using the Top-Down option as the paste would need to solidify or compact enough to support the equipment. Although earliest reports (Golder 1996) proposed paste deposit lifts of 3 to 4 feet, a later report recommends that the lifts be reduced to 1 foot until actual field construction experience indicates that a thicker lift can be deposited to ensure paste facility stability (Knight Piesold 1997).

In the Bottom-Up option and the Bottom-Up portion of the Combined option, a structural zone of compacted paste would be constructed upslope of the toe buttresses to permit the construction of a 3:1 slope. The paste would be spigotted behind the structural zone at its angle of repose. The outer slope of the structural zone would crest at an elevation of approximately 2680 feet (320 feet high) (see **Figure 2-27**). The Top-Down option would be constructed at the angle of repose (approximately 5:1), resulting in longer overall side slopes than the Bottom-Up option. Compaction of slopes would only occur if found to be necessary under the Top-Down option. This would depend on actual field experience. The Top-Down option would have a crest of approximately 2740 feet (380 feet high); although the crest is slightly higher it would be positioned farther away from the highway (see **Figure 2-28**). The Combined option would have some flatter slopes on the upper portions of the deposit and steeper slopes closest to the highway. The Combined option would have an ultimate elevation somewhere between the first two options, the actual elevation would depend upon when the Bottom-Up component was begun relative to the Top-Down component. It may be possible in final design for either the Bottom-Up or combined option to flatten the outer slopes and deposit the remaining mass of the tailings facility closer to Government Mountain and away from Montana Highway 200 such that the resultant landform would more resemble the Top-Down option. Topographic relief of the upper surface of the paste facility constructed by any of the options could be created by preferential spigotting of the paste and the paste could also be reshaped by dozer to achieve the final grading prior to reclamation. Manipulation of the paste to vary the side slopes could be done more easily during construction under the Top-Down option than under the Bottom-Up option. The paste material would be reclaimed on the surface and outer edges when final grade was achieved and timing of reclamation varies somewhat depending upon the option used (see **Reclamation**).

A system of basin drains would be incorporated into any of the options to maximize recovery of seepage of residual process water in the paste and storm water infiltration through the paste. A blanket drain adjacent to the outer slopes and beneath the compacted structural zone would be constructed to maintain a drainage of the structural zone under the Bottom-Up option and the Bottom-Up portion of the Combined option. For all options an extensive system of finger drains would be constructed beneath the paste facility. Conceptually these drains would consist of 4-inch diameter, slotted pipe surrounded by a zone of crushed rock 10 feet wide and 2 feet thick. The actual location of these finger drains would be determined during the final design. The water collected by the finger drains would be routed to a single collection pond located outside the main buttresses (see **figures 2-27** and **2-28**), pumped back to the paste plant and, if not needed for paste production, returned to the mill for reuse.

Land would be cleared and topsoil salvaged in advance of paste deposition (see **Reclamation** for more detail). While a tailings impoundment would require the entire footprint of the impoundment to be

cleared or disturbed prior to construction of the impoundment, the paste deposit alternative restricts disturbance to the active areas. There would be more land disturbed initially under the Bottom-Up option due to construction of the toe buttresses and blanket drain than under the Top-Down option (see **Table 2-11**).

TABLE 2-11
Summary of Estimated Active Versus Reclaimed Areas Over Time for Alternative Paste Facility Construction Scenarios

Year	Area of Active Disturbance	Area at Final Grade (reclaimable area)	Total Area	Comments
BOTTOM-UP CONSTRUCTION SEQUENCE				
YR 0	0 acres	0 acres	0 acres	
YR 7	78 acres	0 acres	78 acres	Southern face under construction
YR 19	190 acres	0 acres	190 acres	Southern face completed
YR 21	97 acres	115 acres	212 acres	25% of top completed to final elevation
YR 31	74 acres	190 acres	264 acres	50% of top completed to final elevation
YR 33	41 acres	250 acres	291 acres	75% of top completed to final elevation
YR 34	0 acres	305 acres	305 acres	100% of top completed to final elevation
TOP-DOWN CONSTRUCTION SEQUENCE				
YR 0	0 acres	0 acres	0 acres	
YR 7	57 acres	2 acres	59 acres	5:1 depositional surface started across 1/2 of northern boundary
YR 10	110 acres	4 acres	114 acres	5:1 depositional surface completed across northern boundary
YR 14	105 acres	48 acres	153 acres	25% of top completed to final elevation
YR 20	119 acres	80 acres	199 acres	50% of top completed to final elevation
YR 26	121 acres	135 acres	255 acres	75% of top completed to final elevation
YR 33	93 acres	211 acres	304 acres	
YR 34	0 acres	305 acres	305 acres	100% of top completed to final elevation

Note: Disturbed acreages do not include soil stripping in advance of paste deposition. If soil is removed for a distance of 500 feet in advance of paste deposition, an additional 30 acres of disturbance can be assumed.

Source: Hydrometrics 1997

Storm Water Control

All storm water detention and retention ponds would be lined with 30-mil HDPE liners for primary seepage containment. The mill pad underdrains would provide secondary collection for the mill site. Underdrains or blanket drains according to final design specifications would provide secondary collection of storm water seepage through the tailings paste facility.

The lined storm water pond at the mill would be enlarged along with all diversions to handle a 100-year/24-hour storm event. Storm water collected at the adit portal and mill sites would be collected and recycled to the mill for reuse. Water collected from the outer slopes of the mill pad and the mill site underdrains would only be allowed to discharge under conditions specified in the revised MPDES permit (see **Appendix M**). Otherwise water from the underdrain containment pond would be pumped back to the mill for reuse. Storm water diverted from undisturbed lands above and adjacent to the mill would be discharged

through overland flow diffusers or energy dissipating outlets outside the 300 foot streamside-buffer zone (see **Figure 2-23**).

Since the tailings paste facility and the undisturbed portion of the disposal site would not retain storm water like an impoundment, one or two lined storm water ponds would be constructed at the lower elevations in the tailings disposal site (see **Figure 2-22**). These ponds would be removed and reclaimed after the tailings facility was completed and reclaimed. These ponds also would be sized to handle the runoff from the active portion of the tailings paste facility site during an 100-year/24-hour storm event. Water collected in the storm water pond could be pumped to the paste plant and then to the mill as process water or used for irrigating reclaimed portions of the tailings paste facility if water quality was acceptable.

Sediment and runoff control of the tailings facility would be handled in two methods. First, limiting unreclaimed areas to the active disposal areas could minimize sediment and runoff. Second, localized sediment retention structures and BMP's would be used in the downslope perimeter of the active panels for control, sampling and recovery of drainage from the tailings paste facility, sediment, and storm water runoff. These structures and collection ditches would act as storm water diversions to channel the water and sediment from the active portion of the tailings paste facility into the tailings facility site storm water ponds. The ditches would also be sized to accommodate a 100-year/24-hour storm event.

Storm water from undisturbed lands above the tailings paste facility would be diverted around the active portions into the north fork of Miller Gulch and to Rock Creek during mine operations. Runoff from reclaimed and fully revegetated, stabilized portions of the tailings paste facility would be diverted to settling basins before mixing with runoff from undisturbed areas. Settling ponds for runoff from newly reclaimed areas along the perimeter of the tailings paste facility would be unlined and would discharge through a constructed drainage network to existing drainages. However, settling ponds on the upper portion of the paste facility would require lining to prevent excess infiltration of water. Storm water from reclaimed areas that were not fully stabilized would be captured along with runoff from the active areas of the tailings paste facility. Undisturbed portions of the paste facility would either drain into existing drainages or be diverted away from active areas, soil stockpiles, and the storm water pond. All these diversions would be sized to handle a 100-year/24-hour storm event. These diversions would be reclaimed and permanent drainage ways established when mine operations ended and the site was fully reclaimed.

The final design for the storm water and sediment control structures at the paste facility must be approved by the Agencies prior to being constructed.

Water Use & Management

Water Use and Supply. Water use and supply for evaluation and underground mining operations would remain the same as described for Alternatives II through IV in the draft EIS. **Figure 2-30** provides a schematic diagram of project water handling for mine operation during the end of mine life.

FIGURE 2-30 Schematic Diagram of Project Water Handling Production - Final Year

Additional water balance detail can be found ASARCO's Alternative V Water Management Plan (Hydrometrics, Inc. 1997b). Process water for the mill would come from five sources: reclaimed tailings slurry water, mine discharge water, reclaimed concentrate slurry water, mill site and tailings paste facility site storm water, and if needed, make-up-well water. Process water would remain in an essentially closed loop. Approximately 5 to 10 percent of the flow in the process loop will be diverted to the waste water treatment system and fresh water added to the circuit on an ongoing basis to prevent buildup of excess constituents in the process water.

General Waste Water Treatment. Two waste water treatment systems designed primarily for nitrate removal would be installed: an anoxic (low oxygen content) semi-passive biotreatment system and a reverse osmosis treatment system. Neither system would be designated as the primary or back-up system. A portable version of the reverse osmosis system would be built to handle mine discharge water from the evaluation adit and placed at the support facilities site. This unit would be moved to the water treatment facility site if a decision was made to continue with the mining operation and expanded to accommodate greater flows that would occur during mine construction and operation. It may take some time for the biological treatment system to become fully operational during mine start-up when variable flows and conditions could be expected; the reverse osmosis system would have the primary water treatment role during evaluation and mine start-up compared to the passive biotreatment system under Alternative II. ASARCO expects that the biotreatment system would become the main treatment system; however, the reverse osmosis system would still be available to operate during bioreactor upsets or if higher treatment efficiencies were required. A schematic diagram of the biotreatment waste water process is found in **Figure 2-31. Figure 2-32** displays the proposed layout of the water treatment facilities. At the final design stage, modifications to the treatment system may be made depending on a number of factors, including the actual discharge water characteristics, the final MPDES permit limits, and the technology available at the time.

Mine water would flow through a pipeline to the water treatment facility. Sedimentation tanks (clarifiers) would remove a high percentage of suspended solids in the discharge water (at least 95 percent). The sludge from the clarifiers would be taken to the paste plant and incorporated into the tailings paste for deposition. Water leaving the clarifiers would also flow through sand filters for final suspended solids removal (80 percent of the remaining fraction). The partially treated water would then be directed to one or both of the water treatment systems depending on system capacity, amount of flow, and other variable conditions.

Anoxic Biotreatment System. The semi-passive biological system for treating mine water would consist of one or more anoxic biotreatment cells, which would consist of gravel-packed, attached-growth denitrification reactors. An in-ground concrete biotreatment cell designed to treat 100 gpm would be 6 feet deep and 28.5 x 28.5 feet in area (810 ft^2), or about 136 x 136 feet (18,500 ft^2) for 2,300 gpm (maximum design flow). These cell dimensions are based on preliminary design data for 80 percent nitrate-nitrogen removal at 6°C. A maximum of 2 acres would be required to contain either a single large cell or several smaller cells and required support buildings.

The pretreated (clarified and filtered) water would flow through a trickling filter to convert the ammonia to nitrate (nitrification). The trickling filter may need to be enclosed or insulated to allow for proper functioning during colder seasons.

FIGURE 2-31: BIOTREATMENT WASTEWATER

FIGURE 2-32: WATER TREATMENT FACILITY PLAN

The biotreatment process would rely on methanol as the carbon source for the denitrification process instead of the manure and straw included in the passive biotreatment system proposed and discussed for alternatives II through IV in the draft EIS. Methanol at a concentration of approximately 60 mg/L would be continually added to the influent water. Methanol concentrations would be monitored and adjusted as necessary to achieve optimal nitrogen removal. A 300 gallon tank (approximate volume) would be located adjacent to the biotreatment system building for initial use of the biotreatment process. A larger tank would be installed if biotreatment proves to be successful. Daily methanol consumption, if the biotreatment system was the primary waste water treatment system, would range from several gallons during initial startup to approximately 250 gallons during maximum discharge of 2,300 gpm.
Phosphorus may also need to be added for microbial growth. It is estimated that approximately 1 milligram of phosphate (as phosphorus) would have to be added for every 30 milligrams of nitrate (as nitrogen) removed.

Mine water and methanol would enter the bottom of the biotreatment cell(s), and upwards flow through the cells would be controlled by a pump. The cell(s) would be filled with gravel and inoculated with several hundred gallons of sludge taken from the nitrogen-removal recycle loop at the Kalispell wastewater treatment plant. The cell(s) should not require reinoculation. The biotreatment cell(s) would not generate sludge or reject material requiring disposal. Nitrate would have been converted to nitrogen gas (denitrification) and methanol to carbon dioxide; these nontoxic gaseous by-products would be vented to the atmosphere. Relatively small amounts of biomass may be generated which would discharge to the aeration pond where it would be broken down.

After biological treatment for nitrate removal, the effluent would flow to an aeration pond with a 12-hour minimum residence time prior to reaching the final monitoring point before discharging to the Clark Fork River. The aeration pond would be lined with 30 mil HDPE. The aeration pond would include a calm pre-discharge zone and a multi-level discharge structure to minimize suspended solids in the effluent. Excess methanol and biomass from the biological nitrate removal system would be reduced through aerobic biological action. Dissolved hydrogen sulfide, if present, would also be reduced through aeration. At the full flow rate of 2,300 gpm near the end of mine life, the required ten-foot-deep pond would encompass approximately one-half acre. If the effluent did not meet discharge limits, it would be returned to the treatment facility for further treatment.

Reverse Osmosis Water Treatment. Reverse osmosis was selected for several reasons as the second water treatment system instead of ion exchange, which was proposed in the draft EIS. The reverse osmosis system is less complex, requires less operator attention, generates a smaller waste stream, and has no added chemicals. In addition, reverse osmosis technology has been proven to be capable of removing dissolved pollutants, such as nitrate, from water in many large capacity waste water treatment facilities throughout the world. Because the reject water or waste stream cannot be easily disposed of at the project site, the reverse osmosis system would operate at a high recovery rate to minimize the waste volume.

The reverse osmosis would most likely be the primary waste water treatment system used during evaluation and early stages of mine operation. When the biotreatment system became fully operational, the reverse osmosis systems would primarily be used during biotreatment system upsets or maintenance. It may also be used as a polishing step when the effluent did not meet standards. During such an event a portion of the biotreatment system effluent would be treated with reverse osmosis such that the recombined effluent from both systems met the limits of the MPDES permit.

The reverse osmosis system would be housed in a building approximately 66 feet long, 28 feet wide, and 12 feet high. It would contain reverse osmosis units sufficient to treat flows up to 650 gpm, the maximum flow expected in year 5 of production and year 10 of project life. The modular nature of reverse osmosis would allow simple installation of additional reverse osmosis units if reverse osmosis were still required for the treatment of 100 percent of the mine discharge in later years of mine operation. These units are complete with high-pressure pumps, cartridge filters, membrane modules and all other necessary equipment. This operation would probably require one operator around-the clock initially and after operations had been finalized, only a day-shift operator. The clarifier and media filters would probably be located outside the reverse osmosis building.

Once the influent water had undergone pretreatment for removal of suspended solids, the reverse osmosis could run continuously and reduce dissolved ion concentrations, including nitrate, nitrite, ammonia, and metals, by more than 90 percent. As flows increased during the life of the project, additional modules could be incorporated easily into the existing facility. Routine maintenance would include instrument calibration, chemical cleaning, and periodic membrane replacement. Membranes would require replacement every three to five years.

Only minimal quantities of brine (liquid waste from the reverse osmosis process containing elevated levels of nitrate, nitrite, ammonia, metals, and other ions) would be generated if the biotreatment becomes the primary treatment system with occasional use of the reverse osmosis. The waste brine that is generated, approximately 10 percent of system inflow when reverse osmosis treatment is required, would either be stored and gradually blended back into the biotreatment treatment system or crystallized/evaporated. The waste would not be classified as a hazardous waste as defined in 40 CFR 261.21-261.25. The brine or crystallized solid would not be ignitable, corrosive, or reactive and it would be non-toxic based on EPA's Toxicity Characteristic Leaching Procedure (TCLP) criteria (Hydrometrics, 1997a). Estimated concentrations of waste brine presume no nitrogen removal by biotreatment. Waste brine concentrations would decrease in direct proportion to nitrogen removal efficiencies in biotreatment.

The brine would be stored in 500,000 gallon, epoxy-coated, covered, vertical, bolted steel tanks (60 feet in diameter and 25 feet high). A single tank would provide 5 days of brine storage for the initial 650 gpm RO facility. Three tanks would be required to hold approximately 5 days of brine storage for estimated maximum mine operation waste water flow of 2,300 gpm.

A crystallizer/evaporator would be installed on site to treat any RO brine generated. The brine would be reduced to one 55-gallon drum of waste per day for every 250 gpm of water treated. This waste would either be stored in drums or in a tanker trailer based on the actual waste volume being produced. The end product would be a solid which could be used by fertilizer companies in western Montana, Idaho, eastern Washington, and Canada or disposed as a regulated waste in an approved landfill such as those in Missoula, Kalispell, and Spokane.

Transportation

Access to the evaluation adit and the minor improvements to FDR No. 2741 would remain the same as for alternatives III and IV as described in the draft EIS. Evaluation adit construction workers would be bused from the relocated support facilities site along FDR No. 150 and 2741. Road maintenance and snow plowing of FDR No. 150 would also remain the same. FDR No. 150 would be realigned with Montana Highway 200 as described for Alternatives III and IV in the draft EIS. However, FDR No. 150 would

connect to an old existing road in the vicinity of the waste water treatment plant if final siting proved the old road to be suitable. This modified alignment would take advantage of an existing road farther away from Rock Creek and reduces the amount of new construction. This existing road would be upgraded and paved and a new segment constructed to connect to existing FDR No. 150 approximately 1200 feet above the confluence with Engle Creek as described for Alternative III in the draft EIS. However, mine construction workers would be bused from the support facilities site until FDR No. 150 had been relocated and the parking lot at the waste water treatment plant had been constructed. The relocated portions of FDR No. 150 and the parking lot at the proposed waste-water treatment facility site would be constructed during the first part of the development phase (year 2) to keep construction related-traffic away from Rock Creek, to provide a road capable of handling the expected mine construction-related and public levels of traffic, and to allow for busing of mine adit construction workers to the mill site and mine portal. Access to the paste plant and the tailings paste facility site from the mill would require mine vehicles travel down FDR No 150 to Montana Highway 200 and then northwest on the highway to Government Mountain Road and then southeast on FDR No. 150B.

All roads used during mine operation between the mill, the mine, the paste plant, the water treatment facility, the highway, and the rail loadout facility would be paved or gravel (see **Table 2-12** and **Figure 2-22**). FDR No 150 above the mine and the Chicago Peak Road, FDR No. 2741, would not be paved. The service road, FDR No. 150B, around the outer edge of the tailings disposal site from the paste plant to Government Mountain Road would be paved; a short stretch of maintenance road along the west side of the disposal site would be gravel. FDR No. 150B from the paste plant to the junction with FDR No. 150 would be reconstructed as a gravel road and used only for pipeline maintenance after mine production begins. FDR No.150B would be gated at both ends and access would be restricted to mine-related traffic. The existing bridge over Rock Creek near the junction of FDR nos. 150B and 150 would not be reconstructed because there would be no concentrate hauled from the mill to the rail loadout facility; however some repairs may be necessary to provide safe crossings for trucks hauling waste rock to the paste facility site during mine development. If during mine operation this bridge deteriorated and the Forest Service determined it was unsafe, it would be removed by ASARCO. A 10-foot wide gravel maintenance road would be constructed along the cross-country portion of the discharge water pipeline between the Clark Fork River and FDR No. 150. A small parking lot for 6-8 vehicles would be required at the paste plant for operators' and mine management vehicles and supply deliveries.

Truck hauling of concentrate from the mill to the rail loadout facility would be replaced by pipeline transport of the concentrate. This would eliminate eight trucks per day making the round trip between the mill and the loadout facility. ASARCO must submit a traffic management plan to mitigate impacts on harlequin duck as well as grizzly bears. This plan would address evaluation, construction, and operation mine-related traffic (excluding public recreation, Forest Service, logging traffic and other private and public traffic). The plan must include provisions for busing employees during mine construction and operation between the waste water treatment facility area and the mill and mine. A parking lot capable of handling the parking needs of the largest shift plus visitors to the mine, estimated at 150 to 175 vehicles, would be necessary. The most logical place for this parking lot would be adjacent to the waste water treatment facility (see **Figure 2-32**). Busing employees from this location would reduce the mine construction- and operation-related traffic to primarily supply vehicles, mine management vehicles, and two or three buses twice per shift including the administrative workers shift.

TABLE 2-12
Summary of Roads To Be Used
Under Alternative V

Road	Section	Type	Length	Width	Access
FDR 150	Hwy 200 to mill site	Paved	5.5 mi	24 ft	Open
FDR 150	Mill site to FDR 2741	Gravel	0.19 mi	20 ft	Open
FDR 2741	FDR 150 to evaluation adit portal	Gravel	1.25 mi	20 ft	Open only when there is no snow, plowed during year 1, but no public parking/turnarounds available during winter
FDR 150B	FDR 150 to paste plant	Gravel	1.07 mi	14 ft	Locked gates/ASARCO pipeline maintenance access only
FDR 150B	Paste plant to Government Mtn. Rd.	Paved	1.52 mi	14 ft	ASARCO and supply traffic only
FDR 150	Government Mtn. Rd. From FDR 150B to rail loadout facility	Gravel	0.19 mi	24 ft	Open
Access Rd.	FDR 150 to parking area/waste water treatment plant	Paved	0.15 mi	24 ft	ASARCO, visitor, and supply traffic only
Access Rd.	North from 150B along west side if disposal site	Gravel	0.52 mi	14 ft	ASARCO maintenance only
Access Rd.	From Hwy 200 to Clark Fork River	Gravel	0.57 mi	10 ft	ASARCO pipeline maintenance only
Access Rd.	FDR 150B to paste plant	Paved	0.37 mi	14 ft	ASARCO and supply traffic only

A portion of FDR No. 150B may be removed and reclaimed after the tailings paste facility has been reclaimed and the paste treatment plant decommissioned, removed, and reclaimed. The need for closure, reclamation, or modification of Forest System roads used by ASARCO during mine operation to gravel or dirt roads would be determined by the KNF at mine closure. The post-mining treatment of roads would depend on forest land uses, needed road densities, and KNF's ability to maintain paved roads versus gravel or dirt roads.

Utilities

Evaluation activities at the adit would be powered with propane generators instead of diesel generators. The support facilities would be supplied with power from a local distribution line as described for Alternatives II through IV in the draft EIS.

The original proposal called for two 500 kW diesel-fired generators; Alternative V replaces the diesel generators with two propane-fired generators (545 kW and 735 kW).

A single utility corridor would be developed along FDR No. 150 and would include the transmission powerline, a tailings slurry pipeline, ore concentrate pipeline, mine discharge pipeline, and return water pipeline (see **Figure 2-24**). The pipelines would split into two corridors at the junction of FDR nos. 150 and 150B. The tailings slurry pipeline and concentrate pipeline and a return water line would follow or parallel the FDR No.150B road alignment to the paste plant. The concentrate pipeline and return water line would continue along FDR No. 150B and a short stretch of the Government Mountain Road to the rail loadout facility. The mine water discharge line and a return water line would follow the new FDR No. 150 alignment to the waste water treatment plant and the discharge line would continue to the discharge outfall in the Clark Fork River and connect with the make-up water well located adjacent to the river. See **Table 2-13** for information on the size and types of pipe proposed for use.

The transmission line would follow the same route along the new FDR No. 150 and existing FDR No 150 from a new switchyard on an existing 230 kV line near Montana Highway 200 to the mill as described for alternatives III and IV in the draft EIS. The substations at the mill and in the impoundment area would remain the same as for alternatives II through IV. The rail loadout facility and the relocated evaluation adit support facilities site would be supplied power from a local distribution line along Government Mountain Road. Although the draft EIS identified a power provider, no power provider has been selected for supplying the mine's estimated annual consumption of 95,000,000 kW-hours.

Erosion and Sediment Control

ASARCO would be required to implement all BMPs detailed in its permit application and which are described in the draft EIS. These include measures for fugitive dust control, site grading, soil handling, surface water protection, and revegetation. In addition, a vegetation management plan would be developed by ASARCO and approved by the Agencies to minimize disturbance during clearing and construction and to maximize revegetation success on all cut-and-fill slopes and reclaimed road segments. A field review would be required by agency hydrologists/soil scientists after facilities and roads have been staked in the field but before construction begins to identify any additional BMPs needed on a site-specific basis. There will be 114 acres of sediment reduction work done as mitigation for BMP's being less effective than planned.

Employment

Estimated employment would remain as described for Alternative IV in the draft EIS; a peak employment of 350 workers during mine construction and 340 during mine operation. Evaluation adit employment would peak at 55 employees in the fourth quarter of the year of evaluation construction. The paste production plant and waste water treatment facility would require specialized operators to ensure proper facilities operation.

TABLE 2-13
Summary of Pipeline Information for Alternative V

Pipeline	Location	Size	Type
Tailings Slurry Line	Mill to paste plant	16 to 24 inches(1)	Steel/polyethylene dual-wall pipe w/leak detection
Tailings water return line	Paste plant to mill	16 inches	Dual-wall pipe w/leak detection(2)
Mine discharge pipeline/make-up water pipeline(3)	Mine to waste water treatment plant to Clark Fork river diffuser	12 to 14 inches	Single-walled pipe w/leak detection
Mine segregation water pipeline (option for later development)	Mine to waste water treatment plant	10 inches	Type undetermined at this time
Concentrate pipeline	Mill to rail loadout facility	3 inches	Dual-wall pipe w/leak detection(2)
Concentrate return water line	Rail siding to paste plant	2 inches	Dual-wall pipe w/leak detection(2)
Storm water return pipeline	Paste facility site storm water retention pond to paste plant	6 inches	Single-walled pipe w/leak detection

Source: Hydrometrics 1997

Notes: (1) The final pipeline diameter will need to be determined based on tailings viscosity and topographic analysis of final pipeline corridor.
(2) The type of dual wall pipe has not been determined at this time.
(3) Mine water is estimated to meet mill make-up water requirements; however, a contingency make-up water well site has been identified near the Clark Fork River in the event that insufficient mine water is available. In this event, make-up water would utilize the discharge pipeline.

Adit Closure

The adit closure plan would need to be finalized and submitted to the Agencies for review and approval prior to mine closure.

The evaluation adit would be plugged with reinforced concrete at mine closure. Since this adit would be a decline and the portal is above the water table, the purpose of the plug would be primarily to close off access and eliminate any potential for surface water inflow.

The service and conveyor adits would be plugged with reinforced concrete near the elevation of the orebody within the mine. This would prevent 1,500 feet of water pressure that would develop if adit seals or plugs were placed at lower elevations in the adits. The adits would be closed at the portal with non-mineralized waste rock to prevent access. Drainage from the portal (inflow to the adits below the elevation of the plugs) would be treated until it meets water quality standards without treatment at which time it would be

allowed to infiltrate into the reclaimed mill pad and underlying alluvium. Monitoring data would be used to establish discharge requirements prior to the time of adit closure.

Reclamation

Reclamation of the evaluation disturbances, adits, mill site and utility corridors would remain the same as described for Alternative IV in the draft EIS. The revegetation plan and seed mixes are described in Appendix G of the draft EIS. A detailed reclamation plan that covered revegetation of all mine facilities would need to be submitted for Agency review and approval before implementation. The plan would provide the means to ensure adequate reclamation and minimize visual impacts of the project. Plans for reclaiming any Forest System roads, if required, would be submitted to the Forest Service for review and approval.

Pipeline Corridor Reclamation. The pipeline would be built and installed and covered with at least 24 inches of soil that had been salvaged prior to construction. No trees or shrubs would be seeded along the pipeline corridor, but any trees or shrubs that volunteered would be left. Trees that encroached on powerline conductors or were in the way of maintenance vehicles would be removed. Maintenance or replacement of a pipeline liner would require some redisturbance of a small area that would be immediately reclaimed after the work was done. When the pipelines were no longer needed they would be removed for a distance of 15 to 20 feet from stream crossings and where the pipes surfaced at the mill, the paste plant, the waste water treatment facility, and the Clark Fork River. The pipes would be completely drained, capped, sealed, the ends reburied, and the redisturbed section regraded, stabilized if necessary, and revegetated. The remaining buried segments of the pipeline would remain in place.

Reclamation of Tailings Paste Facility. Reclamation of the tailings paste facility would be somewhat different from that of a traditional tailings impoundment. Concurrent topsoiling and reclamation would allow the portion of the top and outer slopes of the paste facility that had achieved final grade to be reclaimed while the next segment was constructed. However, the timing of final reclamation would vary somewhat depending upon which option is selected. Final reclamation of the Bottom-Up option would occur on an annual basis unless specified otherwise by the Agencies. Reclamation of a small portion of the Top-Down option could begin in year 7 of mine operation (see **Table 2-11**) and could only be done when the row had reached its maximum height as each succeeding paste layer would cover the preceding layer. The sides and top of the Top-Down option could still be reclaimed concurrently with the stripping of soil from the next area proposed for disturbance rather than waiting until the facility was completely constructed. Reclamation of the Combined option would depend upon which method was being used at the time.

Interim reclamation would occur on an on-going basis for all paste options. An interim seed mix would be added to the paste before its deposition to limit erosion off paste slopes during operations and to reduce aesthetic impacts. A color tackifier or hydroseeding could also be applied to deposit lifts as needed for interim reclamation and stabilization prior to initiation of final reclamation activities. Both toe buttresses and paste deposit slopes for any of the deposition options would be seeded annually with final revegetation mix on any portion that reaches final grade.

Because the paste would be deposited in rows, layer upon layer, soil would be stripped just ahead of the extent of the proposed disturbance for each layer. The soil stripped from the first two or three rows would need to be stockpiled for reclaiming the final segment and outer slope. At times soil being salvaged may not be suitable for the portions of the facility that need to be reclaimed; this soil would also need to be stockpiled until needed. The soils would be segregated according to rocky or non-rocky soils and first lift versus second

lift and, if necessary, stockpiled adjacent to the deposit site (see **Figure 2-22**). Sufficient volumes of the colluvial and alluvial soils, including their rocky subsoils, within the tailings paste facility footprint would need to be salvaged and stored for use in reclaiming slopes 8 percent or greater and along reconstructed drainage ways to minimize erosion. Based on experience and preliminary research to control erosion at Golden Sunlight Mines, the lacustrine soils could be mixed with the rocky subsoils or crushed bedrock to produce a soil with 20% rocks greater than 1 inch in diameter. The mixed soil must also have less than 20% very fine sand in the fine soil matrix (Golden Sunlight Mines 1995). The lacustrine soils could be placed on all slopes less than 8 percent (approximately 12.5:1) without the addition of rock materials as long as the slope length is limited by armored drainageways or other erosion control features. Soil would be salvaged in a two-lift process with the first lift being the more suitable topsoil and the second lift being subsoils excavated up to 36 inches; average total salvage depth equaling 24 inches. Replaced soil depths would average 24 inches over the tailings paste facility. The final design of the paste facility would need to include a volume determination of soil types needed based on the slope breakdown of the paste facility.

ASARCO would need to conduct a detailed soil survey to more accurately determine the amounts and types of soils available for reclamation prior to construction of the paste facility and associated facilities. Since rocky materials are also needed for constructing the toe buttresses, the survey is especially important to ensure there is enough material available for both requirements or to identify the need to obtain more rocky material from other sources than has been estimated in **Table 2-10**.

The tailings paste could, if needed, have organic amendments or fertilizer added to the uppermost lift. This material, which would have no cement added, may need to be ripped prior to topsoil replacement to minimize the development of a root-barrier zone. Both regrading this material and selective placement of the paste during deposition would be used to create diverse topographic pockets, swales, ridges and surface water drainages constructed to a predetermined surveyed gradient in the final design. Overall outer slopes would range between 2H:1V and 5H:1V. These slopes would be protected against erosion using best management practices described in detail for Alternative II in the draft EIS. The compacted slopes of the Bottom-Up or Combined option would have less potential for slope variability due to the method of construction and would have a general appearance similar to that of a conventional tailings impoundment. The flatter slopes of the Top-Down option appear to offer greater flexibility to develop a more natural appearing landform.

Trees would be planted on each segment as it was reclaimed and seeded with approved planting mixes of grasses, forbs, and shrubs. ASARCO has planted trees for screening between the main power line and Montana Highway 200; however, the planting would be inspected during evaluation activities and any dead, dying or missing trees would be replaced to achieve the required density.

ASARCO would be required to submit detailed design, regrading, and revegetation plans for all mine facilities for Agencies' approval in conjunction with the final design of the paste facility. Landform design for the tailings paste facility would incorporate topographic templates from the surrounding area to help meet reclamation goals and Forest Service visual standards. These plans would result in reclaimed sites that decrease landform and vegetation differences between mine facilities and surrounding natural landscapes. Final reclamation of portions of mine facilities, such as outer slopes of the mill site pad and completed portions of the tailings paste facility would be done as early as possible to assist in decreasing the visual impact of the project. Toe buttresses and paste layers creating the deposit surfaces for all options, and the compacted paste zone of the Bottom-Up option, would be designed to minimize straight horizontal crests, long linear contours and uniformly sloping surfaces; however, stability requirements would have precedence. Contours of reclaimed surfaces, including those on the top surface of the deposit, would mimic those of

surrounding topography. Both regrading and selective placement of the paste during deposition would be used to create topographic pockets, swales, ridges and surface water drainages. Rocky soils and possibly cement additive would be used in steepened drainageways to create naturalized swales and help break up the massiveness of the deposit.

Monitoring and Mitigation Plans

ASARCO would be required to submit for Agency review and approval the monitoring and mitigations plans described for Alternatives III and IV in the draft EIS (also see **Appendix H** for summaries of these plans). These plans include: rock mechanics monitoring, water resources monitoring, wildlife monitoring, aquatics and fisheries monitoring, and reclamation monitoring. Additional or modified plans are briefly described below.

Acid Rock Drainage and Metals Leaching Plan. Alternative V incorporates recommendations from a third party technical analysis and risk assessment (Failure Modes Effects Analysis) that evaluated geochemistry data that relates to the Rock Creek Project (Klohn-Crippen 1997). This plan would include additional testing (of the Rock Creek Project and Troy Mine) before and during operations to confirm the mineralogy and geochemistry of ore, waste rock, and tailings, monitoring of water quality in surface and groundwater, and a response plan for collection and treatment of contaminated water. In addition, selection of waste rock to be used in the paste facility buttress would be based on mineralogy and acid base accounting and kinetic leaching tests.

Influent and Effluent Monitoring. The influent to the water treatment systems would be monitored for nitrogen and other parameters identified in the revised draft MPDES permit and the monitoring plan attached in **Appendix H**. Characterizing the influent is critical for maintaining a consistent effluent. The influent would be monitored continuously so that system adjustments could be made whenever required.

Monitoring the effluent frequently is also critical in determining whether the treatment systems are operating properly and allowing adjustments to be made to the system to maintain a quality discharge. Effluent measurements would be made more frequently than required in the draft MPDES permit; the revised draft permit would require weekly or monthly monitoring depending on the parameter. Nitrates would be measured continuously with an on-line analyzer. These water quality results would be verified through weekly or monthly samples, depending on the parameter, and would be analyzed by a certified lab for permit compliance purposes.

Monitoring of Biological Oxygen Demand (BOD). Methanol would be added to the ABCs in an amount sufficient to sustain biological activity, but in small enough amounts to avoid excess BOD in the effluent. Excess BOD, similar to excess nitrogen, could cause unwanted aquatic growth. BOD in the effluent would be measured on at least a weekly basis.

Wildlife Mitigation Plan. All mitigations proposed under Alternatives III and IV in the draft EIS would remain, with the following additions. Design features to prevent disturbance to harlequin ducks during breeding season include limited operating seasons during construction, busing of mine employees, change in location of evaluation adit support facility to lower elevation, eventual closure and obliteration of FDR No. 150B, screening of disturbance zones, area closures of Rock Creek during critical breeding season periods, and water quality monitoring and hazardous material spill plan relative to harlequin ducks. Additional harlequin duck mitigations are planned and identified in the Wildlife Mitigation Plan pending agency and

ASARCO negotiations. Design features to prevent road impacts to fisher include wildlife diversion structures along FDR No. 150. Design features would be incorporated at the millsite to avoid attraction and mortality to songbird night migrants.

Mitigation for several species would be accomplished concurrently with grizzly bear mitigation. These would include road closures for wolverine, and securing of private land habitat for fisher and lynx. Although the securing of private land would not create any additional habitat (although road closures increase habitat effectiveness), this mitigation would secure the sites from almost inevitable habitat alteration as a result of regional increases in human development unrelated to the project. Other concurrent mitigation would be funding for personnel to protect mountain goats and other wildlife species through law enforcement, removal of carcasses killed by vehicles from roadsides to reduce mortality risk to carrion eaters, and inform and educate the public about Threatened and Endangered and other wildlife species.

Monitoring leading to an increased understanding of wolverine and mountain goat population trends as a result of mine-related effects and other regional effects, is included in the mitigation plan to help ensure prompt detection of declining population trends, should they occur. Current monitoring levels would not enable wildlife biologists to detect trends in a timely fashion.

Threatened and Endangered Species Mitigation Plan. Nearly all aspects of the Threatened and Endangered Species Mitigation Plan proposed for Alternatives III and IV would be the same. ASARCO would have to provide 2,350 replacement or conservation easement acres as part of the mitigation for grizzly bear. The reduction of mine-related traffic proposed for inclusion in the Wildlife Mitigation Plan, the transportation management plan, and additional road closures would also benefit threatened and endangered species such as the grizzly bear.

Aquatics and Fisheries Monitoring and Mitigation Plan. This plan, prepared and implemented in cooperation with DFWP and the Agencies, would remain essentially the same as described for alternatives III and IV in the draft EIS. However, the sediment source reduction plan would need to incorporate two additional items. ASARCO would be encouraged to negotiate to the extent possible with private landowners in the Rock Creek drainage to repair severe sediment sources such as the eroding bank on Engle Creek, which is believed to be on private lands. The plan would also include measures to improve in-stream sediment transport such that streambed scouring and sediment storage would be enhanced. This strategy will also result in the development of pools and stable riffles; therefore increasing habitats for fish and macroinvertebrates.

Mitigation would include funding for personnel (in conjunction with the personnel mentioned under Wildlife Mitigation) to protect bull and westslope cutthroat trout through law enforcement and informing and educating the public. Angling pressure in Rock Creek and it tributaries would likely increase due to improved access and increased use. Bull trout harvest is not allowed, but the fish is often misidentified by the public. Westslope cutthroat trout are highly susceptible to angling, therefore harvest rate information and protection are needed.

Hard Rock Impact Plan. Under the approved Hard Rock Impact Plan (ASARCO Incorporated 1997), ASARCO expects to hire 80 percent of workers employed directly by ASARCO during construction and operations from the local study area (Sanders County, Lincoln County, and northern Idaho). The expected local hire of mine construction contract labor would be 40 percent. During the first three years of project development, the workforce would total about 70 workers (all directly employed by ASARCO).

During mine start up and operations, ASARCO expects that about 68 of the 340 total mine workers would be hired from outside the study area. Sixty-five percent (44 workers) of the 68 in-migrating operational mine workers are expected to settle in Sanders County; 30 percent (20 workers) are projected to in-migrate to Lincoln County; and five percent (4 workers) are expected to reside in Idaho.

Local governmental units within the defined study area that may be affected by development of the Rock Creek Project include:

1. Sanders County Government (including Rural Fire Districts of Thompson Falls, Trout Creek, Noxon, and Heron)
2. City of Thompson Falls
3. Town of Plains
4. Elementary School District #10 (Noxon)
5. High School District #10 (Noxon)
6. Elementary School District #6 (Trout Creek)
7. Elementary School District #2 (Thompson Falls)
8. High School District #2 (Thompson Falls)
9. Elementary School District #1 (Plains)
10. High School District #1 (Plains)
11. Lincoln County Government
12. City of Libby
13. City of Troy
14. Elementary School District #4 (Libby)
15. High School District #4 (Libby)
16. Elementary School District #1 (Troy)
17. High School District #1 (Troy)
18. Noxon County Water District (Sanders County)
19. Bull River Rural Fire District

ASARCO would pay $883,500 in grants and prepaid taxes during the project impact period. Impact payments are expected to occur in year 1, year 2, and year 4 of the project. In addition to the base mitigation, ASARCO would also be responsible to make conditional payments should actual in-migration exceed projections.

Due to local government fiscal disparities, ASARCO has recommended that tax base sharing should occur between local governments in Sanders County. Tax base sharing would equal five percent for the municipality of Thompson Falls. The elementary school districts in Sanders County would share the taxable value of the mineral development in the following proportions: 75 percent for Noxon Elementary; 10 percent for Trout Creek Elementary; and 15 percent for Thompson Falls Elementary. For the high schools in Sanders County, the tax base sharing would be in the following distribution: 80 percent for Noxon High School and 20 percent for Thompson Falls High School. All tax base sharing would be in effect at those proportions until tax crediting is completed.

Tax crediting is scheduled to begin in year 7 for each local government that receives prepaid taxes. The amount of tax credits available for each year would be equal to 20 percent of total tax credits available, although the amount would be subject to restrictions and limitations as outlined in 90-6-309, MCA, and

inherent in 90-6-307, MCA, and as described in Appendix 12 of the Guide to Implementation of the Hard-Rock Mining Impact Act.

Wetlands Mitigation Plan. The use of tailings paste landfill technology for tailings disposal eliminates the need for borrow materials outside of the paste facility site to construct starter dams although some rocky material would be required for constructing the toe buttresses. The primary mitigation site proposed in the draft EIS relied on the excavation of borrow material from "Borrow Site #3" adjacent to Rock Creek near the tailings impoundment. The elimination of this 7.5 acre mitigation site has required a modification in ASARCO's 404(b)(1) application to the Corps of Engineers (ASARCO, March 26, 1997). Pertinent details and aspects of ASARCO's wetland mitigation plan for Alternative V are provided in **Appendix N**. Changes in the Agencies' 404(b)(1) preliminary showing as a result of these modifications are contained in **Appendix C**. The primary functions and values of the created wetlands would be to reestablish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek and Miller Gulch, and attenuate peak flows.

ASARCO has identified 7.0 acres of higher terraces, benches, and abandoned channels that are typically above the water table and located adjacent to Rock Creek that would be suitable for the development of linear wetlands (see **Figure 2-33**). The Miller Gulch Tributary sites identified in Alternative II would still be used for wetland mitigation (see **Figure 2-33**). Additional mitigation sites have also been identified for use should the proposed sites prove unfeasible or if the projected created wetlands fail to meet the proposed goals of any of the sites. The mitigation sites would be developed for wetland establishment by excavating the sites, topsoiling, and planting appropriate wetland vegetation species. Whenever possible, soils taken from impacted wetlands would be used. These sites would be constructed during evaluation and project construction to allow the maximum amount of time for stabilization and any required modifications to achieve that prior to mine closure and reclamation (see **Table 2-14**).

The upper Rock Creek wetland mitigation site is located on the East side of Rock Creek near mile post 3, north of the confluence of Rock Creek with Engle Creek. The wetlands would be constructed in the streamside terrace. Trees and shrubs would be removed from the site and topsoil stockpiled in non-wetland areas adjacent to the site. Linear channels would be excavated down to groundwater depths, estimated at 6 to 8 feet below the surface. The width of the bottom of the linear channels would vary from 10 to 25 feet. Benches, 6 to 12 inches tall, would be constructed on one or both sides of the bottom to create zones with variable periods of saturation or inundation. Side slopes would vary reflecting excavation depth and adjacent natural topography. In general, one side of the excavation would be relatively steep (40 to 50 percent) with the opposite side constructed at a gentle to moderate slope (10 to 40 percent). Since the wetland hydrology will be provided by groundwater, no amendments would be placed on the channel bottom to decrease the permeability.

FIGURE 2-33: WETLAND MITIGATION SITE MAP

TABLE 2-14
Proposed Acreage and Schedule[1] for Created Wetlands for Alternative V

Wetland Mitigation Sites	Created Acreage	Site Construction	Projected Resumption of Comparable Functions
Miller Gulch Tributary	1.2	Preproduction Year 3	Production Year 22
Lower Rock Creek	1.4	Preproduction Year 5	Production Year 3
Upper Rock Creek Stage 1 Stage 2	 1.1 3.3	Preproduction Year 1 Preproduction Year 3	Preproduction Year 4 Production Year 1
Total Wetland Mitigation	**7.0**		

Note:
[1] Schedule based on 5 years preproduction activity, 30 years production, and 5 years post-production closure and reclamation.

The lower Rock Creek site is located on a gently sloping toe-slope and bench primarily between FDR No. 150 and Rock Creek just opposite the road leading to the paste plant and northwest from the water treatment plant. A small segment would be located west of the road. The site entails a portion of the area designated as Borrow Area 3. Alternative V does not incorporate the use of borrow from this site at the tailings disposal site; however, if the final tailings paste disposal design changes that requirement, the wetland mitigation design would be modified to account for any topographic changes. After tree and shrub removal and soil salvage and storage had taken place, linear channels would be excavated to a depth of 2 to 3 feet with variable widths between 10 and 25 feet. Side slopes would vary between 50 and 20 percent. Small depressions would be constructed along the longitudinal profile of each channel to increase water retention. If necessary, small flow barrier (detention dikes) similar to those proposed for the Miller Gulch Tributary mitigation site would be constructed across the channel to create additional diversity in wetland hydrology by creating longer periods of inundation or saturation upstream of the dike. If scouring occurred at the outlet of the channels, rock energy dissipators would be constructed.

The Rock Creek mitigation sites would be topsoiled with 12 to 13 inches of salvaged soil. The sites would be revegetated with a herbaceous revegetation mix. Channel side slopes and any berms created with excavated materials would be seeded with the project's standard upland herbaceous mix as described in the draft EIS. Since the narrow configuration of the mitigation sites would preclude effective drill seeding, the sites would be broadcast seeded. The sites would then be mulched with noxious weed-free straw (2,000 pounds/acre) or cellulose fiber hydromulch (1,500 pounds/acre).

PART III: ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER STUDY

A number of alternatives suggested during scoping have been determined by the Agencies to be infeasible or otherwise unreasonable. The alternatives discussed in this section were evaluated and have been dismissed from further consideration. The reasons for dismissal are described in the following sections. Agency evaluations used the Kootenai National Forest Plan (U.S. Forest Service 1987), the MAC Report (U.S. Forest Service KNF 1986), and analyses conducted by ASARCO as part of the project planning process.

Dismissed alternatives relative to the supplemental EIS fall under the seven topics listed below: Additional alternatives considered but dismissed are covered in Chapter 2 of the draft EIS.

- mill and mine portal siting alternatives;
- tailings paste deposition siting alternatives;
- other tailings disposal methods, including backfilling;
- lined tailings disposal facility;
- dry tailings backfill transportation method;
- rail siding (loadout) alternatives; and
- alternate water treatment methods.

Mill and Mine Portal Siting Alternatives

Initial investigations concerning mill and mine portal site alternatives were conducted by the Forest Service and published in the 1986 MAC Report. The MAC Report recommended that the EIS evaluate in detail three mine portal and two mill site alternatives in combinations of sitings. These sites are identified as sites I, J, and K (see **Figure 2-1**). Site I is ASARCO's proposed mill site, Site J is on the ridge above the confluence of East and West forks of Rock Creek, and Site K is the confluence mill site.

Site I was used for the mill in alternatives II and III. Mill and portal site K was used in Alternative IV. According to ASARCO's baseline geology report, Site I was not a feasible portal location because the bedrock there was not suitable.

The two remaining siting alternatives recommended separating the mine portal locations from the mill site. The mill was located at Site K for both alternatives and was connected to a mine portal at either Site I or J by an ore conveyor and access road. Site I was not suitable for a mine portal as described above. Site J was considered, but was dismissed from further study because it was more visible from the wilderness and FDR No. 150 than alternatives III and IV and offered no distinct resource related advantage over a mine portal at Site K.

The MAC Report also considered other mine portal and mill site alternatives but did not recommend them for further study. These include sites in the East Fork Rock Creek and the Bull River drainage. The East Fork Rock Creek sites did not offer any advantages over other alternatives included in the EIS. The Bull River sites were not considered in detail because of distance from portal locations, grizzly bear habitat, and the relatively pristine nature of the potentially affected drainage.

Tailings/Paste Deposition Siting Alternatives

Several tailings impoundment studies have been conducted for this general area. ASARCO conducted an impoundment site evaluation in 1984 before selecting the proposed site. The MAC Report also identified and evaluated 21 potential tailings impoundment sites. U.S. Borax, and later Noranda, conducted impoundment studies in this area associated with Noranda's Montanore Project. The ID team re-examined these reports during preparation of this supplemental EIS with regard to site suitability for tailings paste deposition. Results of these analyses are summarized below. (Refer to the analysis in Appendix E in the draft EIS for a detailed discussion for dismissing these sites for a tailings impoundment.)

The MAC Report (U.S. Forest Service KNF 1986) identified four potential tailings disposal sites for a mine/mill complex located in the Rock Creek drainage. Further discussion of these four sites is included in Appendix E in the draft EIS and Thompson 1989. Of these four sites, three were carried forward for further evaluation, they are: Rock Creek (MAC Report Site 11A), Swamp Creek (MAC Report Site 21), and Noxon Bench (MAC Report Site 10). The fourth site, Rock Creek east (MAC Report Site 12) was eliminated because it was not large enough to handle an impoundment capable of storing the total volume of tailings projected to be generated from mining the Rock Creek ore deposit. During the EIS process, the Agencies added the McKay Creek site to the three identified in the MAC Report, resulting in a total of four sites that were further evaluated as potential tailings impoundment locations. The Agencies reevaluated the four sites from the MAC Report and the McKay Creek site for suitability for tailings paste deposition. The change in the method of disposing tailings did not eliminate the primary reasons for dismissing the use of these sites for a tailings impoundment. Additional reasons relating to paste deposition technology provide more rationale for dismissal from further consideration. **Table 2-15** summarizes these evaluations.

Other Tailings Disposal Methods

In the draft EIS the agencies considered and dismissed two methods of tailings disposal: 1) surface deposition of dry tailings, and 2) backfilling of tailings into the mine using three techniques - sand fraction tailings backfill, slimes fraction tailings backfill, and unsegregated tailings backfill. For detailed information refer to the draft EIS.

Following release of the draft EIS, ASARCO provided additional information on methods of transporting tailings from the surface to the underground mine and disposal through out the mine. These methods mostly centered around the disposal of tailings using recently developed paste handling technologies (Golder Associates, 1996) but also included conveyor transport of dry tailings into the mine.
This information eventually lead to the surface paste disposal concept which is detailed in Alternative V. It is important to note that surface paste disposal is essentially a modification of the dry tailings disposal method which was considered but dismissed in the draft EIS. For more detailed information regarding paste tailings production and handling refer to the paste tailings discussion under the Alternative V description in **Chapter 2**.

TABLE 2-15
Tailings Paste Disposal Siting Alternative Summary

Site	Reason Dismissed from Further Consideration	Reference
Rock Creek East (MAC Report Site 12)	Insufficient capacity to contain all tailings material regardless of disposal method.	MAC Report (USFS 1986)
Both Rock Creek sites (MAC Report Sites 11A & 12)	Increased surface disturbance, increased visual impacts, increased operational costs, increased surface water management needs and monitoring. Need for two paste plants or moving plant from one site to the other or crossing of Rock Creek with high pressure tailings paste line. Would only reduce height of main west-side deposit by approximately 30 feet.	Agency evaluation
Noxon Bench (MAC Report Site 10)	Tailings and reclaim water pipelines crossing the Clark Fork River. Proximity to private residential properties. Need to purchase private property for deposit site.	Thompson 1989 & Agency evaluation
Swamp Creek (MAC Report Site 21)	Tailings and reclaim water pipelines twice as long as needed for the Rock Creek site. Disturbance area 200 acres larger than for the Rock Creek site. Site is privately owned and would require removal of residences. Proximity to other private residential properties. No distinct advantages over the Rock Creek Site.	Thompson 1989 & Agency evaluation
Swamp Creek/Rock Creek Combined Site	Same as for Swamp Creek. Total disturbance area of approximately 700 acres. Need for two paste plants or moving plant from one site to the other.	Thompson 1989
Noxon Bench/Rock Creek	Same as for Noxon Bench. Total disturbance area of approximately 700 acres. Need for two paste plants or moving plant from one site to the other.	Thompson 1989
McKay Creek	Greater impact to Waters of U.S. and wetlands and diversion of a perennial stream. Operational problems due to long distribution lines and numerous pumps or need to construct two or more paste plants or move one plant to more readily reach the entire deposit site.	Thompson 1989 & Agency evaluation
McKay Creek/Rock Creek	Same as for McKay Creek. Paste plants needed in both sites or moved from one to the other. Increased surface disturbance.	Agency evaluation

Paste Backfilling of Tailings

Potential benefits and several potential paste transport and handling methods, as well as the Agencies' rationale for dismissing these alternatives are provided in the following text.

Potential Benefits. These potential benefits of paste backfilling of tailings are discussed below.

Decreased surface disturbance. As with the other backfilling methods that were described in the draft EIS, there are a number of reasons why paste backfill would not allow for all of the tailings to be placed underground. The most important consideration is that rock expands in volume when crushed. Rock Creek deposit ore expands by a factor of 1.67 when crushed to extract copper and silver minerals. That is, one ton of undisturbed ore would have a volume of about 12 cubic feet but processed rock (tailings) would expand to a volume of approximately 20 cubic feet (when rock is ground to small particles, the relative proportion of air space between particles increases - effectively expanding the amount of space a given amount of material requires). Additionally, portions of the mine workings would have to remain open for the entire life of the mine. These include access and ventilation adits, transportation and airway corridors, material processing areas, and other underground facilities. When all of these factors are considered, no more than 40 percent of the tailings could physically be returned to the mine. The remaining 60 percent would need to be stored on the surface.

The remaining 60 percent of the tailings would obviously take up less surface space than would the 100 percent surface deposition alternatives. If paste backfilling were implemented to the maximum extent feasible, and if the height were reduced by 58 feet (an 18 percent height reduction), the surface disturbance of the tailings facility would be reduced approximately 55 to 60 acres (or about 20 percent). Due to the topography of the site, most of the acreage reduction would be along the upper north slope of the site. The overall foot print of the tailings facility would not change dramatically.

Increased ore recovery. Paste backfill could improve the strength of the pillars left in place and could allow the removal of some, but not all, of the pillars, thus improving ore recovery. The strength of the backfill material would dictate if pillars could be removed, how many pillars could be removed, and from which areas pillars could be removed. This would be important should ASARCO wish to remove pillars at the close of the project. However, ASARCO states that pillar removal is not economically feasible and has made a commitment not to rob pillars at the end of mining. Current rock mechanics studies indicate that the risk of subsidence are remote (see Appendix E of the draft EIS for more discussion on subsidence). Paste backfilling for subsidence control is not considered a reasonable requirement given the proposed mine plan (which includes the commitment not to remove pillars) and the strength of the surrounding material.

Decreased mine water inflow. The permeability of the tailings paste would be sufficiently low that water flow through the backfill would be minimal. However, there would still be the possibility of water flow along the paste backfill/rock wall interface (Golder Associates, 1996). Grouting of the rock face would provide a more effective means of reducing ground water inflow than paste backfilling; ASARCO has included grouting for ground water control in its application. Requiring paste backfilling for ground water control would be a less effective and more costly procedure to achieve this goal than other conventional methods.

Paste Backfilling Transport and Handling Methods. Paste backfilling with whole tailing or a segregated portion of tailings that meets the particle size distribution criteria needed to create paste (fine particle content of at least 15 percent by weight less than 20 microns in size) has been evolving for the past two decades in Germany, South Africa, Canada, and Idaho[1]. Testing by ASARCO has shown that the proposed Rock Creek project mill grind will produce tailings with the qualities necessary to make paste. Paste production involves dewatering the tailings to approximately 20 percent by weight. Paste has unique behavioral properties which allow it to be handled in pipelines under conditions not possible using traditional slurry pipeline transport. Since it is nonsegregating when allowed to rest, it can be transported to a placement site without the typical solids settlement problems often associated with slurries. The paste production process also allows for the mixing of additives such as Portland cement or fly ash, materials which can increase the strength and durability of the tailings paste material.

Paste backfill systems are most effective and economic when they take advantage of gravity feed from a mill located above and in close proximity to the ore body. The mill at the confluence of the east and west forks of Rock Creek (Alternative IV) would be approximately 3 miles away from the ore body at a 12 percent gradient - well below and laterally distant from the ore body. The analysis of paste backfill for the Rock Creek project required investigation into two methods of transporting the paste into the mine (paste pumping, and slurry pumping) as well as the concept of operating an underground mill and paste plant to entirely avoid the up hill transportation requirement.

A description of these three methods follows along with the rationale for the Agencies' dismissal of these methods.

Surface paste plant and paste pumping. Transporting the paste via a pipeline was considered because of the paste's characteristics described above. This method would require a high pressure pipeline from the mill to the mine and then to the different mined out areas to be backfilled. The positive displacement pumps required are limited to pumping 3,000 to 4,000 feet per single pump at a flow of 100 tons per hour. Because of the maintenance requirements and the problems that could occur with pump break downs, there would need to be duplicate backup pumps at each pumping station. There have been problems with positive displacement pumps in underground mines with long horizontal distances, such that some gold mines in South Africa abandoned tailings paste backfill for high-density slurry backfill (Golder Associates 1996). The Rock Creek project would not only have a long horizontal distance problem to overcome. Instead there would be a 3 mile long uphill grade to pump the tailings paste before reaching the mine. Then there would be a relatively long distance (up to 1.5 miles) and varying grade to reach the farthest corners of the mine areas. This method was eliminated from consideration because of the operational concerns and because this type of system would not be capable of pumping the required 4,000 tons of tailings paste per day from the mill into the mine.

Slurry pumping and underground paste plant. This method would require pumping the tailings from the mill up gradient to the mine vial a series of slurry pumps. Backup pumps would be required as slurries tend to separate into a dense tailings layer and free flowing water when movement of slurry is halted.

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[1] Mines where paste has been used include: Bad Grund Mine in Preussag, Germany; several South African mines; Inco's mines in Sudbury, Ontario, Canada (including the Garson Mine); and Hecla Mining Company's Lucky Friday Mine in north Idaho (Golder Associates, 1996). Paste is used at these mines as a backfill medium where adverse ground conditions require the use of fill to stabilize underground mine workings or, when found to be cost effective, to assist in maximizing ore extraction.

Restarting the flow of tailings slurry would be difficult or impossible, possibly requiring a back flush of the entire pipeline prior to restarting. There would need to be an underground paste plant and high pressure pipeline distribution system constructed to make the paste and transport it to the mined areas. Slurry tailings backfill placement would not be feasible for reasons described in the draft EIS. Water removed from the slurry when dewatered to paste consistency would need to be returned to the mill for reuse as processed water via a separate pipeline. It could not be commingled with mine drainage that would be sent to the waste water treatment plant for discharge to the Clark Fork River. This method was eliminated from consideration because of operational concerns.

Underground mill and paste plant. The previous three methods dealt with the need to transport tailings from the mill, up into the mine. The 3 mile, 12 percent (Alternative IV) gradient pipeline or conveyor transport requirement was considered to be one of the primary problems. An underground mill located near the primary crusher would eliminate that problem.

There would be reduced ore transportation systems and reduced surface disturbance at the confluence mill site. Three major problems would reduce the feasibility of an underground mill. The first relates to project development. The mill space would need to be excavated into waste rock and built before any ore processing could begin. Any ore above it or in the vicinity of the mill would need to be transported out of the mine and stored until the mill was operational; then the ore would need to be transported back up the adit to the mill. Second, the majority of the waste rock from driving the adits has been proposed for use in creating the mill site pad in Alternatives IV and V. Under the underground mill concept there would be considerably less embankment needs. This excess material would either need to be disposed of in a waste rock pile in the vicinity of the mine portal and the abandoned surface mill site or hauled down to the tailings disposal site for use in constructing the embankment for an impoundment, key buttress for a paste deposit, or burial under the tailings in the body of the tailings disposal facility, depending upon the method of surface disposal being used and thus increasing the volume of material stored there. The last item of concern deals with the need to get sufficient electrical power to the underground mill The large electrical lines would require sufficient clearance for safety reasons which might require large adits resulting in additional waste rock to be disposed of. Power could be supplied, however, the system would be extremely costly and could pose a safety hazard to miners who would be sharing confined area (adit) with high voltage lines. The primary reasons for eliminating this type of facility to achieve paste backfilling are the concerns about stockpiled ore on the surface during development, increased visual impacts from disposal of larger volumes of waste rock, and operational considerations. This facility would also require an underground paste plant and pipeline distribution system with problems as described above.

Dry Tailings Backfill Transportation Methods

Conveyor Transport. Conveyor transport does not take advantage of paste technology. Instead, it depends on drying tailings to a point that they do not flow. This method would take advantage of the return belt of the ore transporting conveyor. The tailings would need to be dried to a filter cake at the mill, loaded onto the return side of the main conveyor, transferred to an underground surge bin, and then transported to the mined out workings via trucks. This method requires additional facilities at the mill site for dewatering 4,000 tons of tailings per day. This may result in additional disturbances at the mill site and would require additional capital costs and manpower to build and operate this facility. The primary reason why the conveyor transport would not be feasible is the operational aspect of operating a dedicated fleet of trucks to transport the tailings from the underground surge bin to the mined out workings. There would be additional

requirements for ventilation as there could be as many as 16 to 20 trucks in operation of ore hauling and backfilling. Traffic congestion within the mine would be a major problem, especially early in mine life when there is less maneuvering room available. In addition to operational factors and health and safety concerns, which are the primary reasons for eliminating this method of transportation, there would be additional capital and operational costs to the company to acquire, operate, and maintain the fleet of trucks, and employ the additional drivers.

Lined Facility

As a result of comments received in response to the draft EIS, a report (Dames & Moore, 1996) was prepared examining lined impoundment options using both natural and synthetic materials. The conclusion of the report indicated that the reduction in seepage through the bottom of the impoundment was less than an order of magnitude between the lined and unlined cases. This conclusion was in part based on the inherent low hydraulic conductivity of the tailings slimes providing a natural barrier to seepage. Conversely, the installation process for synthetic liners or other manufactured products can introduce construction error which can translate into higher than expected seepage rates through otherwise very "tight" material. Although there was a demonstrated reduction in seepage volume when using a liner, the degradation of water quality in violation of water quality laws was not predicted even when no liner was assumed. Referencing the draft MPDES permit, the analysis indicated that the mitigations of pumpback wells which were introduced as part of Alternative III were sufficient to decrease the concentrations of nitrate and metals (after mixing) emanating from the impoundment to justify finding the discharge "nonsignificant". The Agencies decided that the MPDES analysis demonstrated that a lined impoundment was not necessary to maintain water quality. While lined impoundments are customarily used in conjunction with toxic effluents such as cyanide or heavy metals, the projected chemical concentration and signature of the Rock Creek tailings effluent did not warrant the use of a lined waste facility.

The Dames & Moore report also included cost projections for the different lined options. These cost estimates ranged from a low of $3.4 million for the impoundment as proposed by ASARCO to a high of $29.6 million for a synthetically lined impoundment. While cost alone is not a criterion to dictate alternatives development, when looking at the cost in comparison to the net benefit in environmental protection from lining the impoundment, the Agencies determined that there would not be an appreciable gain in benefit from this option.

Rail Siding (Loadout) Alternatives

As discussed in Alternatives Description, ASARCO proposes to haul copper/silver concentrates produced at the mill by truck to the existing Hereford railroad siding 3 miles north of Noxon adjacent to Montana Highway 200. A covered tractor-trailer combination would haul concentrates to a newly constructed loadout facility between 8 a.m. and midnight, 7 days a week. Transporting the estimated 51,000 tons of concentrate produced annually would require about eight round trips per day.

In consultation with the shipping railroad, Montana Rail Link, the Agencies developed the following alternatives to find a rail siding location that would limit or eliminate the amount of time and miles concentrate trucks would be on Montana Highway 200. The Agencies also considered proximity to dwellings as noise and lights could affect persons living nearly. All alternate rail siding locations are technically feasible as to grade (siding and access road) and right-of-way width.

Modified Miller Gulch

Access to this siding location would be via Montana Highway 200 from the junction of new FDR No. 150 for about 1.0 mile to existing FDR No. 150, then over 0.75 mile of Government Mountain Road, and finally over about 0.25 mile of new road to the siding. About 1,200 feet of track would have to be constructed, at a cost of $220,000 (see **Figure 2-34**).

The proposed means of accessing this rail siding from Montana Highway 200 has been dismissed. Increased traffic congestion and decreased safety would be greater than the project proposal. Concentrate ore trucks would not reach designated highway speeds before having to slow down to make turns off the highway. However the rail siding site was retained for alternatives III through V with access via FDR No. 150B around the impoundment.

Rock Creek Rail Spur

No highway access would be necessary for this alternative. Access would be via a new road connecting FDR No. 1022 and new FDR No. 150. The combined 13,000 feet of new access road and track would cost about $800,000 to $1 million and would need to cross both Rock Creek and Miller Gulch (see **Figure 2-34**).

The Rock Creek Spur alternative was dismissed because it would require another bridge crossing of Rock Creek and greater cost. In addition, Montana Rail Link (MRL) prefers not to build dead-end spurs.

Noxon Rapids Dam South

The Noxon Rapids Dam South rail siding alternative would require some additional road construction. The existing road intersection with Montana Highway 200 does not meet MDT criteria for sight distance. An alternative would be to construct the Montana Highway 200 intersection immediately across from the FDR No. 150 intersection. Such an intersection would preclude ore trucks from having to pull onto the highway and then exit 0.25 mile away. About 1,500 feet of road would need to be constructed from Montana Highway 200. Then about 800 feet of existing road, Noxon Dam Road, and the Montana Highway 200 intersection would be obliterated. A 0.25-mile segment of new road would have to be constructed to access this siding location. Either side of the main line could be used for rail siding. About 1,200 feet of track would have to be constructed, at a cost of $200,000 (see **Figure 2-34**).

The Noxon Rapids Dam South alternative was dismissed because the access to it uses the Washington Water Power's (WWP) road and passes immediately adjacent to their barracks. It is also within 200 yards of the reservoir, a potential problem in the case of a spill.

Noxon Rapids Dam North

Access to this site would be from new FDR No. 150 and north onto Montana Highway 200 about 0.5 mile. Trucks hauling concentrate from the mine would have to turn left (west) onto an unnumbered road paralleling the south side of Rock Creek, leading to the rail siding. About 1,200 feet of track would have to be constructed, at a cost of $200,000 (see **Figure 2-34).**

FIGURE 2-34 Rail Siding (loadout) Alternatives

The Agencies dismissed this alternative because it would increase congestion on Montana Highway 200 and decrease safety more than the project proposal. Concentrate trucks would not reach designated highway speeds before trucks would need to slow down to make left-hand turns. The alternative is also in close proximity to WWP's barracks. MRL stated that this was not a feasible site due to railroad alignment.

Other Water Treatment Methods

Water treatment alternatives that were considered and dismissed by the Agencies include: (1) land application disposal (LAD) of excess mine adit discharge and mill process water, (2) constructed wetlands, and (3) conventional suspended growth nitrification/denitrification treatment. The LAD alternative consists of several disposal options including percolation ponds, drip irrigation, and spray irrigation. The constructed wetlands option consists of wetland cells, ponds, and a meadow. Conventional suspended growth nitrification/denitrification treatment may require two separate treatment steps to reduce dissolved nitrogen. The rationale for dismissing each option is provided below.

Land Application Disposal

Percolation Ponds. Potential sites for percolation ponds or infiltration galleries were identified on about 100 acres of the Clark Fork River gravel terraces, and on 15 acres of Rock Creek alluvial deposits. These sites were selected because of their ability to transmit large volumes of water. It was estimated up to 1,700 gpm of excess water could be disposed of in a series of percolation ponds. The use of percolation ponds would be restricted by severe winter weather conditions for at least part of the year.

The use of percolation ponds was dismissed as a primary alternative for disposing of excess mine and process water for several reasons. The use of percolation ponds on gravel terraces or alluvial deposits would likely result in the formation of springs and seeps that would directly discharge into Rock Creek and the Clark Fork River. Springs and seeps could cause erosion and increased sediment loading to the receiving streams. In addition, the percolation ponds would have little effect on the initial quality of the discharge. ASARCO estimated that the maximum removal efficiency for nitrate and ammonia that they could obtain using a combination of percolation, infiltration, and spray or drip irrigation was 20 percent. The potential would exist to affect ground water quality and existing beneficial uses of ground water.

Drip or Spray Irrigation. Two irrigation sites were identified for disposal of excess water by either drip or spray irrigation. One site consists of approximately 160 acres and is located on a hill to the northeast of the proposed tailings impoundment. The other site consists of about 225 acres located north of Montana Highway 200 between Rock and McKay creeks. Up to 800 gpm could be disposed at the two irrigation sites, less than half of the average anticipated discharge during operation. Relatively large areas of land would be disturbed, and the cost of maintenance would be high.

Drip or spray irrigation could be used only for about 150 days of the year; freezing, precipitation, and saturated soil would reduce soil infiltration capacities, hampering operations the remaining 215 days. Spray or drip irrigation by itself could remove a larger percentage of nitrogen (up to 80 percent) if the volume to be treated was much lower or there was adequate land available. Based on these considerations, the use of drip or spray irrigation was dismissed from further consideration as a primary means of wastewater treatment.

Constructed Wetlands

Constructed wetlands treatment consists of a primary sedimentation basin, wetland treatment cells, shallow pond, and wet meadow. The critical design criterion for sizing the components of a constructed wetlands is the hydraulic residence time (HRT); the total time that water remains in the treatment cells prior to discharge. Based on typical HRTs of 5 to 7 days to achieve 80 percent treatment (primarily denitrification), the required area for the wetland cells was calculated to be approximately 100 acres. Furthermore, additional area would be required for the sedimentation basin, shallow pond, and wet meadow. Based on preliminary calculations, the constructed wetlands treatment option was dismissed because adequate land area within the proposed permit area does not exist. There is also the possibility that the constructed wetland would not be as effective during winter months.

Conventional Nitrification/Denitrification Treatment

Conventional suspended growth nitrification/denitrification treatment has been used to remove nitrogen from domestic wastewater at many wastewater treatment facilities throughout the United States. Such treatment has been shown to be effective on a variety of wastewater under a variety of climatic conditions. However, such treatment facilities are complex and may require multiple steps and high rate solids recycling and can be difficult to operate. The construction costs for a conventional suspended growth nitrification/denitrification facility are estimated to be 30 to 40 percent more than the proposed trickling filter - ABC nitrogen removal process. Operating costs are also greater for a conventional suspended growth nitrification/denitrification facility and are estimated at 80 to 100 percent more than the proposed trickling filter - ABC nitrogen removal process.

PART IV: DESCRIPTION OF REASONABLY FORESEEABLE ACTIVITIES

This section discusses reasonably foreseeable activities proposed near the Rock Creek study area. Reasonably foreseeable activities are those that have been proposed in specific enough detail to allow evaluation at this time.

Conservation Plan for Bull Trout

On June 13, 1997, the U.S. Fish and Wildlife Service (USFWS) proposed that the Columbia River population segment of bull trout be listed as threatened according to the Endangered Species Act (ESA). Assuming that this decision (expected in June 1998) is made final, the ESA requires that a conservation plan be drafted for this species. The primary responsibility for drafting such a plan lies with USFWS, but input is sought from various federal and state agencies and tribal governments within the affected geographical region. The governors of both Idaho and Montana have created teams to draft recovery plans for bull trout. A draft recovery plan for Idaho's bull trout was published in January 1996 (Batt 1996). Montana's team, which includes members of federal and state agencies, the Confederated Salish-Kootenai Tribes, the American Fisheries Society, Plum Creek and the National Wildlife Federation, is drafting a recovery plan for 12 bull trout watersheds in Montana. If appropriate, the contents of these plans will be included by USFWS in their recovery plan. The recovery plan would include specific conservation measures that could affect all projects within the geographic range of this population segment.

Tri-State Implementation Council's Proposed Plans

A Tri-State Implementation Council has been established by the Clark Fork-Pend Oreille Basin Water Quality Steering Committee to implement management actions outlined in the management plan (EPA 1993). The council consists of representatives from federal, tribal, state, and county agencies along with citizens and special interest groups. Although the council has no regulatory or enforcement authority, it has important roles and responsibilities which include, but are not limited to the following: building strong citizen, community and agency support for the plan; coordinating the activities of the various agencies implementing the plan; developing timetables; identifying funding; establishing criteria for success; identifying or revising priority recommendations; communicating with appropriate groups as needed; providing a forum for public input and support; and overseeing ad hoc sub-committees to implement specific action items at the local community level.

Water quality "management objectives" contained in the plan that could have implications to the proposed Rock Creek Project include:

- Control nuisance algae in the Clark Fork River by reducing nutrient concentrations;
- Protect Lake Pend Oreille water quality by maintaining or reducing current rates of nutrient loading from the Clark Fork River; and
- Reduce near-shore eutrophication in Lake Pend Oreille by reducing nutrient loading from local sources.

Proposed initial management actions for the state of Montana to voluntarily implement these three objectives include the following items. However, if the state of Montana implements any of these action items, participation by waste water discharge permittees in affected stream segments may become mandatory if goals were not met voluntarily.

- Establish a basin-wide phosphate detergent ban;
- Establish numeric nutrient loading targets for the Clark Fork River and Lake Pend Oreille (the latter to be done by the state of Idaho) and implement a nutrient allocation strategy if voluntary nutrient control measures are unsuccessful in protecting water quality;
- Require nutrient monitoring as a condition of all wastewater discharge permits;
- Enforce an aggressive antidegradation policy with respect to nutrient sources;
- Develop and implement a nonpoint source management plan specifically for the Clark Fork Basin;
- Establish and maintain a water quality monitoring network to monitor effectiveness and trends and to better identify sources of pollutants; and

- Implement seasonal land application and/or other improvements at several municipal waste water facilities or industrial operations or modify nutrient limits for surface and subsurface discharges for some operations.

The Clark Fork River from its headwaters downstream to the Flathead River confluence is on Montana's list of water quality-limited waterbodies. Voluntary industry nutrient waste load allocation reductions are being encouraged[2] and supported by the state of Montana to restore water quality along this stretch of the Clark Fork River. If voluntary actions fail to achieve the needed improvements, the state will be required by EPA to use a formal, regulatory, permit-based approach to improve water quality in the Clark Fork River. The discharge point for the Rock Creek Mine would be located in a stretch of the River that is not on the state's water quality-limited list. However, nutrients in the mine's waste water discharge could negate some of the upstream nutrient control measures and also affect nutrient loading to Lake Pend Oreille.

Total Maximum Daily Load Allocation for Lake Pend Oreille and the Clark Fork River

The Clark Fork River in Idaho is listed as water quality limited due to metals pollution. Lake Pend Oreille is listed as water quality "threatened" due to increasing development and other concerns. Both waters are scheduled for development of a problem assessment and a total maximum daily load allocation (TMDL) designed, respectively, to recover the impaired use, and to protect existing water quality. TMDL's are measured in loads (for example, lbs/day), not concentrations (for example, mg/L), to reveal the cumulative impacts of a discharge. On July 1, 1997 work was begun on developing a TMDL for Lake Pend Oreille and the Clark Fork River, with an anticipated completion date of December 1999. When the TMDLs become effective, Montana must meet these limits at the border. This may or may not require a change to ASARCO's discharge permit depending on the outcome of the problem assessments.

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 ASARCO Rock Creek project. ASARCO has petitioned to delist Rock Creek. 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 alteration and thermal modifications resulting from dam operation and construction but is not listed as requiring a TMDL. Although no TMDL's for these waters are currently being developed by the State of Montana, the potential for the TMDLs exists.

[2]Voluntary measures include items such as upgrading the Missoula city water treatment plant to achieve a 90 percent reduction in phosphorus and nitrogen loading to the Clark Fork River.

Relicensing of Noxon Rapids and Cabinet Gorge Hydroelectric Dams

Washington Water Power (WWP) initiated relicensing activities in the fall of 1995 for their two hydroelectric facilities on the lower Clark Fork River - Noxon Rapids and Cabinet Gorge dams. The current license for Cabinet Gorge will expire in 2001. WWP has received authorization from the Federal Energy Regulatory Commission (FERC) to accelerate the Noxon Rapids license expiration date from 2005 to 2001 to coincide with the expiration date for Cabinet Gorge. This will allow a concurrent relicensing process for these two facilities. WWP plan to file an application with FERC in February of 1999. FERC will then prepare a draft and final EIS.

Prior to filing of the application, WWP is conducting a series of consultation meetings and workshops in Montana and Idaho with state and federal agencies, non-governmental organizations, affected Indian tribes, and local organizations, clubs, and the general public to attempt to reach consensus on present and future resource goals and management objectives for the project area. This consensus agreement, or settlement agreement, could become part of the application to FERC. FERC initiated project scoping in July 1996 to better understand agency and public concerns related to relicensing and to begin to fulfill its obligations under NEPA.

Initial baseline studies were conducted from 1993 to 1995 by WWP to characterize resources associated with the projects, including fisheries, wildlife, vegetation, recreation, water quality, and cultural resources. On-going studies that would supplement initial baseline information generally address:

- protection and enhancement of native salmonid populations in the lower Clark Fork basin, and general fisheries management;
- maintenance and improvement of water quality;
- availability and adequacy of recreation opportunity at Noxon and Cabinet Gorge reservoirs;
- protection of reservoir shorelines;
- cultural resources protection plans;
- development of a decommissioning plan and fund;
- loss of pre-dam conditions and habitats;
- wildlife and plants; and
- other miscellaneous study requests and questions.

Agencies, WWP, and involved parties are looking into a number of potential mitigations that may be affected by the ASARCO Rock Creek Project or that might duplicate or complement mitigations included with one or more of the alternatives analyzed by the Agencies. Potential mitigation and enhancement measures for bull trout and other fish, water resources, recreation, land use, aesthetics, wildlife, vegetation,

wetlands and cultural resources for dam relicensing are not known at this time, but may be cumulatively affected by or affect the Rock Creek Project.

Cumulative effects of these potential measures and other activities (including Rock Creek project) will be assessed in the NEPA documentation. Any new information will be assessed in relation to this project and subsequent decisions pursuant to NEPA and implementing regulations.

Timber Sales

The Cedar Gulch timber sale (2-3 MMBF) was held in 1996 and is on NFS lands adjacent to the ASARCO project area. Any other sales that might be proposed, will be subject to analysis under NEPA at the time of proposal. Sales may be modified or possibly dropped depending on the outcome of the assessment.

Logging on private lands has occurred over the past few years. Additional logging of private lands in the Rock Creek drainage can be expected to occur over the next 30 years. However, there is no information available to predict when and where they would occur.

Montana Highway 200 Improvements

Montana Highway 200 is a paved, double-lane roadway that begins at the Montana-Idaho state line and travels across Montana to the North Dakota border. This highway is in varying stages of reconstruction. In 1996 it was reconstructed from milepost 14 to 23. Depending on availability of state funding, reconstruction is tentatively scheduled from milepost 62 to 68.7 in 1998; and Thompson River bridge east to milepost 62 in 1997. The junction of existing FDR No. 150 with Montana Highway 200 is about milepost 17.5 on the highway.

Noranda Minerals Corp.

Although the Agencies approved construction of the Montanore Project (as described in alternatives 3C and 5 of that project's final EIS) in various decision documents (DSL, 11-92; KNF, 9-93; Department of Natural Resources and Conservation (DNRC), 11-92; DHES, 11-92; and COE, 10-93) it has not yet been constructed. Noranda's modified plans are for continued evaluation and development of the project in a phased approach. The proposed project would consist of six primary components: an underground mine, a mill, three adits and portals, a tailings impoundment, access roads, and a 16.7-mile transmission line. (See **Figure 2-35**.) Access to the project is via U.S. Highway 2, Bear Creek Road (FDR No. 278), Libby Creek Road (FDR No. 231), and upper Libby Creek Road (FDR No. 2316). Although some of Noranda's ore body is less than 1 mile from ASARCO's, the surface facilities would be almost 7 miles apart. Additional information on the Montanore Project can be found in the draft EIS for the ASARCO Rock Creek project and the permit application (Noranda 1989) and final EIS for the Montanore Project.

FIGURE 2-35 Montanore Project Proximity

Road Access

The owners of record of two landlocked private properties located in portions of Sections 28 and 33, Township 27 North, Range 31 West, and in portions of Section 12 and 13, Township 26 North, Range 31 West, have submitted special use permit applications for the construction of dry season roads to their property.

The Libby Ranger District on the Kootenai National Forest is preparing an Environmental Impact Statement (EIS) to assess and disclose the environmental effects of the proposed road construction. The decision areas are located approximately 24 and 26 air miles respectively south of Libby, Montana on the east side of the Cabinet Mountains Wilderness.

PART V: COMPARISON OF ALTERNATIVES

The alternatives analyzed in this EIS were developed in response to the significant issues identified during scoping. The Agencies identified eight significant environmental issues to drive development of alternatives and evaluation of impacts. (See **Issues** and **Development of Alternatives Process** for more detail.)

The next two tables summarize the descriptions of the action alternatives. **Table 2-16** provides a side-by-side comparison of mine development and operation features of each alternative. **Table 2-17** compares the reclamation planning aspects of each alternative. These alternatives are described in detail earlier in this chapter. A detailed discussion of the alternatives' impacts is contained in **Chapter 4**. The following section summarizes the impacts, their magnitude, and level of significance, and discusses how impacts relate to the issues that drove alternative development.

Consequences of the Proposed Project and Alternatives

All alternatives would result in impacts of varying magnitude, duration, and importance to resources with regards to the eight issues discussed under Identification of Issues. However, as proposed, all action alternatives for the Rock Creek Project would result in potentially significant or significant impacts to environmental resources specified in six of the issues. They are briefly summarized below:

Issue 1: Effects on quantity and quality of Montana and Idaho surface and ground water resources.

In Montana, effects are predicted to impact

- aquatic invertebrates from sediment and nutrient loads (alternatives II and III);
- surface water quality from spills and pipeline ruptures (all action alternatives); and
- wilderness lake water levels and aquatic life from remote possibility of subsidence (all action alternatives).

TABLE 2-16
ASARCO Rock Creek Project Alternative Comparison

Project Facility or Feature	Alternative II ASARCO Proposal	Alternative III Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V Paste Backfill & Alternative Water Treatment
Mill Site	Upper end West Fork Rock Creek	Same as Alternative II	Confluence of East and West forks Rock Creek	Same as Alternative IV
Tailings Impoundment	Rock Creek site 325 feet high, 324 acres, upstream construction	Same as Alternative II except modified centerline design w/technical review panel	Same as Alternative III	Same location at Alternative II but utilizing paste
Adit Waste Rock Dump	Southeast of adit 600,000 tons	Above mill site 600,000 tons, some used to create millsite	No waste rock dump. 1,000,000 tons used to create mill site and starter berms	Same as Alternative IV
Mine Adit, Length & Grade (to underground crusher)	Up Chicago Peak Rd (FDR No. 2741) 9,000' @+12.7%	Same as Alternative II	At confluence mill site 15,530' @+12%	Same as Alternative IV
Mine Adit Access	New 1.41 mi. road @+6.5%, 20' wide with 75' ROW, graveled	FDR No. 2741 reconst 1.26 mi. to 24' wide gravel & unnamed spur, reconst 0.21 mi. to 20' wide graveled	All within mill site boundary except for short spur off of FDR No. 150 for large equipment	All within mill site boundary
Evaluation Adit Length & Grade	Up FDR No. 2741 6,592' @-10%	Same as Alternative II	Same as Alternative II	Same as Alternative II
Evaluation Adit Waste Rock	178,000 tons, Placed downhill of adit entrance	Same as Alternative II	Same as Alternative II	Same as Alternative II
Evaluation Adit Road, Length & Grade	Upgrade FDR No. 2741 for 4.6 mi. & reconst 0.18 mi. spur to 20' wide	Same as Alternative II	Same as Alternative II plus improve 2.8 miles of FDR No. 150 above confluence mill site	Same as Alternative IV
Evaluation Adit Water Discharge Line	6" polyethylene line approx 8.5 mi. both X-C & along Rd 150, laid on surface for 3 yrs	Same as Alternative II	Same as Alternative II	Same as Alternative II
New Road Construction	(1) 1.22 mi. new const beginning of FDR No. 150, 24' paved	(1) 2.3 mi. new const beginning of FDR No. 150, 24' paved (different location than Alternative II)	(1) Same as Alternative III	(1) Same as Alternative III but 1.62 miles
	(2) Const 1.07 mi. of 14' graveled road around mill	(2) Same as Alternative II except 24'	(2) N/A	(2) N/A
	(3) N/A	(3) Const 1,200' to connect FDR No. 150 to FDR No. 1022, gravel, 14' wide	(3) Same as Alternative III	(3) Same as Alternative III
	(4) Const 2.33 mi. of 14' graveled road from Sec. 15 to impoundment and const 1.02 of 10' graveled road in Sec. 3 & 10, both along slurry/reclaim lines	(4) Const 3,200' of 14' gravel road along slurry line, Sec 3 & 10	(4) N/A	(4) N/A
	(5) N/A	(5) 400' of 10' road for slurry/reclaim line (Rd150-B to water reclaim pump)	(5) Const 0.04 mi. of 24' paved road into mill site	(5) Same as Alternative IV
	(6) Const 1.43 mi. of 14' road around S & W of tailings imp for access to dam base and seepage collection line	(6) Const 1.6 mi. of 14' road around S end of tailings imp for access to dam base & rail load-out (paved w/turnouts)	(6) Same as Alternative III	(6) Same as Alternative III
	(7) N/A	(7) Const 1,200' of 14' road to access rail load-out (paved)	(7) Same as Alternative III but paved	(7) Same as Alternative IV
	(8) N/A	(8) Const 3,000' of 10' road - gravel for seepage collection line	(8) N/A	(8) Const. 22 mi. - 14' of paved road to paste plant
	(9) Mine Adit Access 1.41 mi. graveled	(9) N/A	(9) N/A	(9) N/A
	TOTALS: 1.22 mi. paved and 7.26 mi. gravel roads	**TOTALS:** 4.2 mi. new paved and 2.6 mi. new gravel roads	**TOTALS:** 4.19 miles paved and 0.25 gravel roads	**TOTALS**: 3.74 miles paved and 0.25 gravel roads
Road Reconstruction	(1) FDR No. 150 to mill, widened to 24' & paved for 5.1 mi.	(1) Same as Alternative II, but 4.02 mi.	(1) Same as Alternative II except only to confluence mill site, 2.94 mi.	(1) Same as Alternative IV but 3.42 mi.
	(2) FDR No. 150B from FDR No. 150 to seepage collection system 0.96 mi. of 14' (gravel)	(2) Improve FDR No. 150-B for 1.7 mi. from Rock Creek crossing to tailings impoundment, widen to 14' slurry line on inside edge of road (paved w/turnouts)	(2) Same as Alternative III	(2) Same as Alternative III including paste plant access 0.76 mi. paved and 1.07 mi. graveled

TABLE 2-16

Project Facility or Feature	Alternative II	Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V
	(3) Discharge line road to river 0.75 mi. - 10' wide (dirt) (5) Exploration adit road 0.189 graveled	(3) Same as Alternative II but graveled (4) Mine Adit Access, reconst 1.26 mi. of FDR No. 2741 to 24' gravel and spur for 0.21 mi. to 20' wide **TOTALS: 5.72 mi. paved, 2.4 graveled**	(4) N/A (5) Same as Alternative II **TOTALS: 4.64 mi. paved, 0.93 graveled**	(3) Same as Alternative IV (5) Same as Alternative II
Slurry and Reclaim Lines	From mill along FDR No. 150 to approx. center Sec. pressure urethane-lined steel slurry lines on piers, 1 buried 12' steel reclaim line) 3.3 mi. would be X-C, 1.4 mi. along FDR No. 150	on FDR No. 150 to SE of Sec. 22 where it follows FDR No. 150-B to impoundment 0.3 mi. X-C in Sec.	From mill along FDR No. 150 to intersection of old and new FDR No. 150, parallels FDR low pressure polyethylene, (buried)	Same route as Alternative IV but 4 mi. One 16- reclaim water pipeline.
	(1) 12" polyethylene line buried adjacent to road from adit to mill, 6,700' Sec. 15, then parallel's FDR No. 150 to MT Hwy 200, then would parallel hwy for 500', would cross and parallel road to Clark Fork	(1) Buried from adit down ridge 3,000' to mill (2) 12" steel excess water line parallels slurry line to intersection of new FDR No. 150, then parallels FDR same as Alternative II, 7.5 mi.	(2) Follows basically the same route as Alternative	(1) N/A 18" and goes X-C in Section 33 5.7 mi.
Transmission Line 230 kV Pole Line	Parallels existing 230 kV line from switchyard. reconstructed FDR No. 150 to mill, 5.7 mi.	No. 150 & reconstructed FDR No. 150 to mill 6.6 mi. total length	Same as Alternative III except only goes to confluence mill site 5.2 mi.	Same as Alternative III except near waste water
	From adit to mill 2,500' by 42" wide	Same as Alternative II		Same as Alternative IV
Wilderness Ventilation Adit	5,760'	In the cliffs on approx. 150% slope, 400' NE of ridge @ elev of 6,700'	Same as Alternative III	
	At Herford siding	Miller Gulch		Same as Alternative III
Tailings Impoundment Starter Dam Borrow	impoundment & 2 borrow sites (27.2 acres)	Same as Alternative II	735,000 cu. yards of borrow from within impoundment, waste rock from adit construction and borrow site 3 (27.2 acres)	

TABLE 2-16

Project Facility or Feature	Alternative II	Proposed Project w/Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V
Soil Storage (1) Evaluation Adit		(1) Same as Alternative II	(1) Same as Alternative II	
(2) Support Facilities	(2) Adjacent storage; 1.3 ac; 4,193 cy		(2) Same as Alternative II	(2) Same as Alternative II
associated components	(3) Impoundment, borrow areas, pump station	(3) Similar to Alternative II but stockpiles S-1 and S-2 expanded to handle additional volume: S-1 increases to 18.1 ac; 563,227 cy S-2 increases to 16.4 ac; 549,598 cy		(3) Same as Alternative III but 2.2 acres of soil stockpiles insufficient to hold entire required volume but soil would be salvaged incrementally and replaced concurrently.
	cy Water control structures; adjacent storage; 9.2 ac;			
(4) Transportation Corridor	(4) Stored adjacent to each component; total 29.3 ac;	salvage showed clear benefit to revegetation and would not result in excessive disturbance	(4) Same as Alternative III	(4) Same as Alternative III
	(5) Adjacent storage; 10.0 ac; 32,269 cy	(5) Same as Alternative II		(5) Same as Alternative III
(6) Mill Facilities	S-4 north end; 3.4 ac; 56,910 cy	(6) Similar to Alternative II but stockpiles S-1 and S-2 expanded to handle additional volume: S-3 increases to 78,921 cy S-4 increases to 93,560 cy	(6) New location at confluences mill site:	
	(7) N/A	(7) Similar to Alternative II but new waste rock dump location has salvageable soil; stored along toe/sides of		(7) Same as Alternative IV
	Total cubic yards: 655,949	**Total cubic yards: 1,367,649**		**Total cubic yards: 1,313,554**
Mine Adit Water Treatment	and ion exchange system	Same as Alternative II	Same as Alternative II	settling system.
Evaluation Adit Water Treatment	biotreatment and ion exchange system	Same as Alternative II	Same as Alternative II	osmosis with a pilot anoxic biotreatment system.

TABLE 2-17
ASARCO Rock Creek Project Reclamation Comparison

Reclamation Feature or Component	Alternative I No Action	Alternative II ASARCO's Proposal	Alternative III Project With Mitigations	Alternative IV Modified Project w/Mitigations	Alternative V Paste Facility
TAILINGS IMPOUNDMENT					
Soil depth (average)	30 inches	Salvage depth - 11.0 inches Respread depth - 9.5 inches	Salvage Depth: Lift 1 - 11.0 inches Lift 2 - 14.5 inches Respread depth - 24 inches	Same as Alternative III	Same as Alternatives III and IV.
Interim[1] revegetation on dam faces	N/A	None	Interim revegetation with G/F[2] until reshaping completed	Same as Alternative III	Interim mix (where necessary) would be the same as the final mix. Interim seed mix would be added to paste to limit erosion off paste slopes during operations and to reduce aesthetic impacts.
Final revegetation on dam faces	N/A	Phased during construction with seeded G/F/S[2] Containerized S/T[2] years 34-35	Initiated after 7th year of construction. Phased in years 8-33 with seeded G/F and containerized S/T[2] every 3-4 years	Same as Alternative III Same as Alternative III	Toe buttresses and paste deposit slopes would be seeded with final revegetation mix on any portion that reaches final grade annually regardless of option.
Planting plan	N/A	Alternating strips for drill-seeded species (8-feet wide) and containerized species (2- to 4-feet wide), 6-foot spacing for trees	Plans replicate naturally occurring species, densities, and distributions	Same as Alternative III	Same as Alternatives III and IV.
Postmining topography	N/A	Smooth planar faces and abrupt transitions to adjacent topography	Reshaping and grading of faces (years 7-33) every 3-4 years Smooth transitions from human made to natural land forms	Same as Alternative III	Portions of the paste facility and toe buttresses that reach final grade would be reclaimed annually. Smooth transitions from human made to natural landforms.
Associated facilities: soil stockpiles, roads, pipeline corridors	N/A	Interim reveg with G[2]	Same as Alternative II	Same as Alternative II	N/A
	N/A	Final reveg with seeded G/F/S[2] and containerized T[2] on stockpile sites and roads	Final reveg with containerized S/T on stockpile sites as depleted; roads and pipeline corridors immediately	Same as Alternative III	Final revegetation on all operational disturbances as completed. Interim mix (where necessary) would be the same as the final mix.
MILL SITE, PORTAL, AND ASSOCIATED FACILITIES					
Soil depth (average)	21 inches	Salvage depth - 21 inches Respread depth -11 inches	Salvage depths: Lift 1 - 11 inches Lift 2 - 25 inches Respread depth - 24 inches (soil also placed on rock dumps)	Salvage depth: Lift 1 - 19 inches Lift 2 - 6 inches Respread depth - 24 inches	Same as Alternative IV.
Final reclamation	N/A	Revegetation with seeded G/F/S[2] and containerized T[2] after year 33	Revegetation with seeded G/F and containerized S/T[2] after year 33	Revegetation with seeded G/F and containerized S/T after year 4 on pad faces Revegetation on pad surface after year 35	Same as Alternative IV.
Planting plans	N/A	Alternating strips for drill-seeded species (8-feet wide) and containerized species (2- to 4-feet wide), 6-foot spacing for trees	Plans replicate naturally occurring species, densities, and distributions	Same as Alternative III	Same as Alternative III.
Postmining topography	N/A	Abrupt transition to adjacent topography at mill site and portal	Reshaping and grading of mill site and portal area (year 34) to more natural appearing forms Smooth transitions from human made to natural land forms	Same as Alternative III for portal. Shaping of mill pad faces in years 1-4 Reshaping of pad surface after year 34	Same as Alternative IV.

TABLE 2-17
ASARCO Rock Creek Project Reclamation Comparison (Cont'd)

	Alternative I No Action	Alternative II ASARCO's Proposal		Alternative IV Modified Project w/Mitigations	Alternative V Paste Facility
Soil depth (average)	0 inches	Respread depth - 11 inches (soil from mill site area)	Salvage depth: Lift 1 - 24 inches on ≤ 40% slopes. Respread depth: 24 inches with two smaller dumps (additional soil from mill site)	N/A	N/A
Final reclamation	N/A	Revegetation with seeded G/F/S[2] and containerized T[2] in year 35	Revegetation with containerized S/T[2] in year 5	N/A	N/A
EVALUATION ADIT					
Soil depth (average)	Average 9.2 inches over 7.7 acres	Salvage depth: From 4.24 acres: Lift 1 - 6 inches (1.98 acres) and 5 inches (2.26 acres) Lift 2 - 24 inches (1.98 acres) Respread depth (1-2 lifts) - average 13 inches on 4.9 acres (adit, dump top, and part of dump face) Remaining 1.4 acres of face left as talus-like rock	Salvage depths same as Alternative II Respread depth similar to Alternative II but areas respread would coincide with planting plans	Same as Alternative III Respread depth similar to Alternative II but areas respread would coincide with planting plans	Same as Alternative III. Same as Alternative III.
Revegetation	N/A	Seeded immediately after construction with G/F[3] on access road, soil stockpiles, and surface water control features Additional G/F[2] seeding as features are recontoured (as soon as possible after completion of evaluation work)	Interim seeding with G/F[2] on access road, ditches, and soil stockpiles Final seeding of disturbed areas with containerized S/T[2]	Same as Alternative III	Same as Alternative III.
Planting plans	N/A	Uniform G[2] cover on 4.9 acres with 1.4 acres left as talus	Pockets and edges of disturbed areas planted with S/T[2] to achieve mosaic appearance similar to adjacent slopes	Same as Alternative III	Same as Alternative III.
Postmining topography	N/A	Face of dump graded to 2H:IV slope; bench approximately 100-feet wide retained	Dump recontoured to approximate existing contours with no bench	Same as Alternative III	Same as Alternative III.

Notes:
[1]Interim - a temporary grass seed mix used primarily for soil stabilization that would be replanted with a final seed and/or planting mix.
[2] G/F/S/T - Grasses/Forbs/Shrubs/Trees specified for revegetation; see **Appendix G** for seeding and planting proposals.
[3] Same G/F seed mix proposed for interim and final revegetation on evaluation adit.
N/A = not applicable

- No measurable impacts are predicted for surface or ground water resources in Idaho.

Issue 2: Effects on fish and wildlife and their habitats and current and proposed threatened and endangered species.

Effects are predicted to impact

- grizzly bear habitat due to lost and reduced effective habitat (all action alternatives);
- neotropical migrant birds and pileated woodpeckers due to direct and indirect loss of old growth habitat (alternatives II - IV);
- harlequin ducks due to disturbance, habitat alteration, and increased mortality risk (alternatives II - IV);
- sensitive aquatic species (bull and westslope cutthroat trout) due to increased sediment and increased interbreeding with non-native species (alternatives II and III); and

Issue 3: Stability of the tailings impoundment/paste facility.

Effects from impoundment failure are predicted to impact

- surface water quality and aquatic life in lower Rock Creek and Clark Fork River if failure occurred (all action alternatives).

Issue 5: Effects on old growth ecosystems.

Effects are predicted to

- Directly impact 0 to 28 acres of old growth (all action alternatives).
- Change habitat effectiveness from existing condition. Effectiveness would be reduced by 19 to 94 acres (alternatives II through IV), or increased by 1 acre (Alternative V).

Issue 6: Effects on Waters of the U.S. and wetlands.

Effects are predicted to impact

- Up to 9.6 acres of Waters of the U.S. and wetlands and decrease functions and values until mitigation sites, up to 13.8 acres (depending on the alternative), were established (all action alternatives).

Issue 8: Effects on aesthetic quality, including noise, visual, and wilderness experiences.

Effects are predicted to impact

- residents at Hereford (Alternative II only), mountain goats, and travelers on FDR No. 150 due to increases in sound levels from mine activities and traffic respectively (all action alternatives);
- visual quality of Rock Creek and Clark Fork Valley and ability to comply with Forest Service standards due to size, shape, color, texture and contrast of mine facilities with surrounding landscapes and the amount of time needed for reclamation/revegetation to mitigate impacts (all action alternatives); and
- solitude of wilderness users near the ventilation adit due to high visibility and elevated noise levels (alternative II).

Table 2-18 and the following descriptions provide a more detailed summary comparison of the effects of all alternatives with regards to all eight significant issues identified earlier in this chapter.

Changes in Water Resources

Surface and Ground Water Quality. The Agencies analyses are based on assumptions that may vary from actual mining, climate, and site conditions during operation and reclamation and cannot be known completely in advance. These assumptions are reasonable, conservative, and protective of water quality. There are several factors that could affect predicting the levels of impacts to surface and ground water quality for nutrients, certain metals, and sediment. These include actual concentrations of nitrogen in the blasting media used, the number of explosive misfires or incomplete reactions, actual waste rock and ore geochemical content, particle size of waste rock and tailings, actual infiltration capacity of the mill and impoundment sites, rainfall and temperature conditions, actual streamflow, and efficiency of the proposed water treatment facility. Uncertainties in the Agencies' analyses are discussed in detail in **Chapter 4**.

Alternatives II through IV would result in minor (Clark Fork) to moderate short term (Rock Creek) changes in existing surface water quality. The concentrations would be unmeasurable after dilution with Clark Fork River. This would be due in part to the proposed filtration and treatment of discharged water; concentrations of sediment and nutrients would be reduced. It is also due to the dilution afforded by the relatively higher flow of the Clark Fork River.

Waste water treatment would be required as long as water being discharged into the Clark Fork River from the impoundment/paste facility, adits, and underground mine did not meet MPDES effluent limits. The adits could be plugged at their upper end, allowing water entering the adits to drain but holding back water entering the mineralized zone. If the mine adits were not sealed, mine adit water would not be allowed to discharge into Rock Creek as it is unlikely that the adit waters could meet water quality standards relative to Rock Creek. Adit water would have to be perpetually piped, treated if necessary, and discharged to the Clark Fork River. If the adits were sealed after mine closure, mine water eventually would discharge into bedrock, and possibly out through springs whose location cannot

TABLE 2-18
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Water Resources					
Surface water quality	Except for minor increases in sediment, existing surface water quality would be maintained.	Minor increases in metals, nitrogen, ammonia, and total dissolved solids concentrations in Clark Fork River from treated discharges during operations.	Same as Alternative II	Same as Alternative II	Same as Alternative II but with increased treatment reliability and minor increases in phosphorus due to changes in waste water treatment systems.
		Nitrogen loads would be temporarily increased in Rock Creek and the West Fork during mine construction and would impact aquatic invertebrates and algae in the short term.	**Same as Alternative II**	Similar to Alternative II but the aquatic life in West Fork of Rock Creek above the confluence mill site would not be affected by increased nitrogen from mine construction, or waste rock dumps. The 300' buffer zone around confluence mill site would reduce nitrogen loading to Rock Creek.	Same as Alternative IV.
	Sediment-loading for Rock Creek may temporarily increase due to construction of roads and land clearing for timber sales.	Sedimentation would be reduced because timber road construction for NFS lands in the Rock Creek drainage may be limited due to project increased open road densities.	Same as Alternative II. Sediment would also be reduced by relocating a portion of FDR No. 150 and the utility corridor and by identifying and reducing existing sediment sources.	Same as Alternative III.	Same as Alternative III but additional sediment reduction due to fewer roads, paste facility construction, modified reclamation plans, reduction in mine-related traffic, and sediment mitigation on 114 acres.
		Impacts from materials from spills and pipeline ruptures potentially could affect water quality in Rock Creek and the Clark Fork River.	**Same as Alternative II except the potential for material from spills and pipeline ruptures to reach the main stem of Rock Creek is reduced.**	**Same as Alternative II except potential for spills and pipeline ruptures in West Fork of Rock Creek would be eliminated.**	Potential for pipeline ruptures would be reduced because tailing, process water, and ore concentrate pipelines would be double-walled with leak detection. Impacts from spills of ore concentrate would be minimized by piping to an enclosed rail loadout facility.
Ground water quality	Ground water quality would be similar to existing quality.	Ground water quality standards for nitrates and dissolved manganese would be exceeded within an approved mixing zone during construction and operation of tailings impoundment. Downgradient ground water quality would not be affected beyond the mixing zone as a result of a ground water extraction and pump-back system.	Similar to Alternative II, except impoundment seepage would be reduced by using excavated clays to seal permeable contact zones. The technical panel reviewers for impoundment design would investigate the use of seepage reduction techniques (which may include synthetic or clay liners) to further minimize seepage if acid-base accounting of waste rocks indicated potential for acid drainage.	Same as Alternative III.	Tailings paste seepage would be reduced by one order of magnitude to approximately 30 gpm.
Surface water quantity	Appropriated water would continue to be withdrawn from surface water.	Surface flow in Miller Gulch would be reduced during operations.	Same as Alternative II.	Same as Alternative II.	Similar to Alternative II.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Ground water quantity	Ground water well production from appropriated sources would be similar to existing production.	Possible decrease in static water levels in wells not in Clark Fork alluvium and spring flow downgradient of Miller Gulch during operation.	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
		Portal plugging and subsequent mine flood-ing may generate downgradient springs	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
Wilderness lakes and wetlands	Wilderness lakes would continue to experience natural and seasonal water level fluctuations.	**The potential for subsidence is remote. Impacts would be potentially significant.**	**The potential for subsidence, although remote, would be reduced by additional rock mechanics studies and a subsidence control plan. Impacts would be potentially significant.**	**Same as Alternative III.**	**Same as Alternative III.**
		Aquatic life and wetlands associated with Cliff and/or Copper lakes could be significantly impacted if subsidence occurred.	**Potentially significant, short-term impacts to wetlands and aquatic life associated with Cliff and/or Copper lakes would be mitigated in accordance with a mitigation plan if subsidence occurred.**	**Same as Alternative III.**	**Same as Alternative III.**
Wildlife, Habitat, and Threatened & Endangered (T&E) Species					
Grizzly bears	Continued availability of spring and fall grizzly bear habitat.	**Direct physical loss of 585 acres of habitat. Habitat effectiveness would be reduced on an estimated 7,308 acres during operation. This would have a potentially significant impact on grizzly bear habitat. Decrease in habitat effectiveness in all impacted BMU's.**	**Direct physical loss of 609 acres of habitat. Habitat effectiveness would be reduced on an estimated 7,001 acres during operation. This would have a potentially significant impact on grizzly bear habitat.**	**Direct physical loss of 542 acres of habitat. Habitat effectiveness would be reduced on an estimated 6,635 acres during operation. This would have a potentially significant impact on grizzly bear habitat.**	**Direct physical loss of 481 acres of habitat. Habitat effectiveness would be reduced on 6,428 acres during operation.**
	Slight increase in habitat effectiveness due to road closures.	The KNF would need to close 4.8 miles of roads to reduce open road densities to meet the 0.75 miles of open road per square mile standard for bear analysis areas.	Open and total road densities would be reduced. KNF would need to close 3.67 miles of roads to reduce open road densities to meet the standard.	Same as Alternative III.	Same as Alternative III.
		Increased mortality from road kills, poaching, and destruction of nuisance bears.	Similar impacts as Alternative II but somewhat reduced due to additional mitigations.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Other T&E species	Bald eagle use would continue to increase.	**Increases in road-killed deer could slightly and indirectly increase mortality risk of bald eagles along MT Hwy. 200, FDR No. 150, and along the train tracks near the Hereford siding. The increased potential to lose a member of the existing pair of eagles could significantly affect recovery of the species in the area.**	Increases in road-killed deer and associated bald eagle mortality risk along MT Hwy. 200 is less than Alternative II because of rerouting concentrate haulers to the Miller Gulch rail load-out along FDR No. 150B and daily removal of road-killed animals.	Same as Alternative III.	Same as Alternative III.
	Migratory peregrine would continue to use the Clark Fork River drainage.	Similar to Alternative I.	Same as Alternative II.	Same as Alternative II.	Same as Alternative II.
Big game animals	Minor changes in habitat or activities of big game animals; security could be improved as open road densities were reduced. Displacement and possible increased mortality of animals due to increased human development in Rock Creek if ASARCO releases its Rock Creek lands.	Increased potential for animal-vehicle collisions.	Similar to Alternative II.	Similar to Alternative II.	Lowest of action alternatives because of proposal to bus employees.
		Minor loss of habitat for game species including travel corridors, riparian areas and a few small bull elk wintering areas.	Similar to Alternative II.	Habitat loss associated with the mill in the upper West Fork of Rock Creek would be shifted to the confluence mill site.	Habitat loss is the least of the action alternatives.
		Displacement and possible increased mortality of animals due to increased human use and activities (including hunting and poaching).	Somewhat less impact because of road closures.	Similar to Alternative III.	Same as Alternative III.
Neotropical migrant birds	Minor changes in forested habitat or activities of neotropical migrant birds unless ASARCO releases its Rock Creek lands for development, Increased homesites could decrease bird diversity by introduction of pest species and direct habitat loss.	**Direct and indirect loss of old growth, riparian, and wetland habitats would affect songbirds in those areas. Potential loss of individual birds.**	**Same as Alternative II.**	**Same as Alternative II.**	Substantially similar to Alternative I for old growth and same as Alternative II for riparian and wetland habitat.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Sensitive animal species	Stability of harlequin duck population in lower Clark Fork would remain vulnerable.	**Human disturbance and habitat alteration could result in loss of harlequin duck reproduction on Rock Creek. Loss of Rock Creek breeding area would increase vulnerability of the lower Clark Fork harlequin subpopulation.**	**Impacts to harlequin duck habitat lessened with relocation of FDR No. 150 out of the riparian area but remain potentially significant and similar to Alternative II.**	**Similar to Alternative III.**	Impacts to harlequin ducks less than Alternative IV because of busing mine employees, slurrying concentrates and seasonal closing FDR No. 150B: operating limitations, and moving of the evaluation adit support facilities site.
	Habitat for lynx, fishers, and wolverines would continue to be reduced as frag-mentation and habitat degradation continued. Disturbance and mortality risk would continue to increase slowly as regional human population increased.	Fisher and wolverine habitat quality reduction (especially old growth, riparian areas and travel corridors) and disturbance could displace animals.	Similar to Alternative II.	Moving the mill site and impacting less old growth would reduce the impact below Alternative III.	Change in effectiveness of old growth would be essentially unmeasurable. Mortality risk further controlled through mitigation measures.
	Disposition of lands in Rock Creek by ASARCO could increase human development in drainage with resulting impacts to harlequin ducks, fisher and resident birds.	Potential increases in hunting, trapping, poaching, and traffic collision mortality would add to the overall decline of fisher and wolverine security in the Cabinet Mountains, and the region.	Similar to Alternative II.	Similar to Alternative II.	Busing mine employees decreases risk of mortality from vehicle collisions and vehicle disturbance.
Sensitive aquatic species	**Sediment impacts from private and KNF timber sales and other developments could have a significant impact on aquatic resources.**	**Increased sediment in West Fork and mainstem Rock Creek would significantly decrease emergence success of bull and cutthroat trout fry.**	**Modifications and mitigations would reduce the amount of sediment impacting Rock Creek spawning habitat and bull and cutthroat trout.**	Sediment impacts to bull and westslope cutthroat trout would be minimized in the West Fork of Rock Creek. The 300 ft. buffer around the confluence mill site would reduce sedimentation impacts downstream.	Similar to Alternative IV, but lesser amount of disturbed acreage and relocation of evaluation support facily should further reduce sediment impacts.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Sensitive aquatic species (Continued)	Natural changes in aquatic habitat are expected, marginal threat to long-term survival for Cabinet Gorge bull trout stock and long-term risk of loss of cutthroat population due to introgression.	**Reduced bull trout habitat in Rock Creek could significantly impact Cabinet Gorge bull trout.**	**Reduction of existing sediment sources in Rock Creek and Bull River drainages would improve the status of bull trout and cutthroat populations in Rock Creek, and bull trout in Cabinet Gorge Reservoir.**	Similar to Alternative III but 300-ft. buffer around the confluence mill site would further reduce sediment impacts to bull and cutthroat trout in mainstem Rock Creek and bull trout in Cabinet Gorge Reservoir.	Similar to Alternative IV, but negotiation with private land ownders to reduce sediment sources should further reduce sediment impacts.
		Potential increase in non-native fish species and interbreeding with native sensitive species (westslope cutthroat trout and bull trout).	Risk of interbreeding and non-native fish species increase would be reduced due to sediment mitigations.	Similar to Alternative III.	Similar to Alternative III.
		Catastrophic failure of the tailings impoundment could result in an irretrievable loss of sensitive aquatic species, particularly resident fish species.	Similar to Alternative II	Similar to Alternative II	Risk of catastrophic failure of tailings paste facility greatly reduced by using paste technology.
Plant species of special concern	Sixteen populations of 5 different plant species of special concern within the permit area would remain undisturbed. Crested Shield fern was not found in study area.	Nine populations of 4 species of special concern would be eliminated.	Eleven populations of 4 species of special concern would be eliminated if they cannot be avoided during construction.	Same as Alternative III	Same as Alternative III.
Mountain goats	Some of the Rock Peak goat herd could be affected by the Montanore mine which could result in stress or displacement of some goats. If goats are displaced, an increase of goats in vicinity of Rock Creek in summer/transitional ranges could result.	Project-related noise and disturbance would change habitat effectiveness to 85-91% in key summer habitat.	Project-related noise, disturbance, and facility location would change habitat effectiveness to 86-93% in key summer habitat.	Project-related noise, disturbance, and facility location would change habitat effectiveness to 87-92% in key summer habitat.	Similar to Alternative IV.
	Habitat effectiveness is 91% in key summer habitat.	The cumulative effects of the Montanore and Rock Creek projects could result in a decline in numbers.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		Increased mortality risk would occur due to increased human use of the area by recreationists, hunters, and poachers.	Similar to Alternative II, but additional road closures would reduce mortality risk.	Similar to Alternative III.	Similar to Alternative III, but mitigation includes increased law enforcement and monitoring to control mortality risk.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Pileated woodpecker	Habitat availability to sustain local populations of pileated woodpeckers would remain below recommended biologically sound levels. Effective old growth currently is 867 acres.	**Effective old growth would reduce 16% to 745 acres, which potentially significantly affect sustainability of local pileated woodpecker populations.**	**Effective old growth would reduce 5% to 820 acres, which would potentially significantly affect sustainability of local pileated woodpecker populations.**	**Effective old growth would reduce 3% to 837 acres, which would potentially significantly affect sustainability of local pileated woodpecker populations.**	Effective old growth would remain substantially the same, resulting in similar effects as Alternative I.
Impoundment/Paste Facility Stability	No tailings impoundment would be constructed, therefore no risk of failure.	Risk of impoundment failure would be possible but remote. **Impacts from an impoundment failure to surface waters and aquatics would be potentially significant.**	Modified design and construction details as well as a technical panel review of the design would further reduce the risk of impoundment failure. **Same as Alternative II.**	Same as Alternative III. **Same as Alternative II.**	Modified design and use of paste tailings along with a technical panel review of the design further reduce the risk of paste facility failure. **Same as Alternative II.**
Socioeconomics					
Employment	Employment growth would come from service sector jobs.	The project would directly generate up to 433 construction and 355 mine operation related jobs and about 140 indirect jobs. Growth of service sector jobs would be hindered by resource extraction dependent employment.	Same as Alternative II.	Similar to Alternative II but Alternative IV would directly generate up to 350 construction workers, 355 mine operation workers and about 150 indirect jobs.	Same as Alternative IV.
	Employment would continue at existing trends.	The project would generate an employment boom-bust cycle between mine construction and operation phases.	Same as Alternative II.	Mine construction employment scheduling could reduce peak construction to levels closer to mine operation employment and would moderate the boom-bust cycle.	Same as Alternative IV.
Population	Substantial population increase at predicted rate.	Project employment and associated immigration would result in a population increase of approximately 4% in Sanders County, and less than 0.4% in Bonner and Lincoln counties during construction. Mining operations would result in an increase of less than 3% in Sanders County and less than 0.15% in Bonner and Lincoln counties. Population increases in Sanders County could be potentially significant. Would decrease long-term population growth by up to 500 persons.	Similar to Alternative II.	Both mine construction and operations and the associated immigration would result in an increase of less than 3% in Sanders County and less than 0.15% in Bonner and Lincoln counties.	Same as Alternative IV.
Income	Moderately increasing personal income.	The generation of an annual personal income of $9.6 million and indirect income of $1.5 million would increase three-county personal income by 2 percent.	Similar to Alternative II.	Similar to Alternative II.	Same as Alternative IV.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Housing	Existing housing shortages would continue.	Increased housing shortage during mine construction could result in construction of mobile-home court or apartment building. New homes would be built during mine operations resulting in a potential surplus after mine closure.	Similar to Alternative II.	Similar to Alternative II.	Same as Alternative IV.
Community Services	Moderate increases in demand for already burdened community services.	Increased need for law enforcement and fire protection personnel.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		Classroom capacities and school accreditation standards may be exceeded in some communities during construction.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		Some community water and/or wastewater treatment facilities may be unable to absorb additional users.	Same as Alternative II.	Similar to Alternative II but smaller effects during the construction period due to fewer immigrating people.	Same as Alternative IV.
		ASARCO's Hard Rock Impact Plan would help mitigate financial costs associated with resolving project impacts.	Same as Alternative II.	Same as Alternative II.	Similar to Alternative II.
Fiscal	Revenues and government expenses would continue along existing trends.	Increased needs for services would impact Sanders County's ability to finance those services.	Same as Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		Increased property and income tax revenues.	Same as Alternative II.	Similar to Alternative II.	Similar to Alternative II.
Land use	Land use patterns and changes would continue at existing rates and locations.	About 400 acres at impoundment site would be unusable for most existing land uses.	Same as Alternative II	Same as Alternative II.	Similar to Alternative II.
		Approximately 3,074 acres of private lands needed for grizzly bear mitigation would be removed from residential and commercial land uses.	Approximately 2,692 acres of private lands needed for grizzly bear mitigation would be removed from residential and commercial land uses.	Similar to Alternative III except that only 2,536 acres of private lands would be removed from future development.	Similar to Alternative III except that only 2,350 acres of private lands would be removed from future development.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Old Growth Ecosystems (excludes replacement old growth)	Approximately 6.2% of Compartment 711 would remain in effective old growth habitat. This percentage would change over time due to natural succession and natural occurrences, (e.g., fire).	**About 122 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 5.3% of Compartment 711.**	**About 47 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 5.9% of Compartment 711.**	**About 30 additional acres of effective old growth habitat would be lost or degraded. Effective old growth habitat would decline to 6.0% of Compartment 711.**	Essentially the same as Alternative I.
	Effective old growth habitat would remain below the recommended levels to provide for long-term maintenance of old growth dependent species in Compartment 711.	**Biological diversity would be reduced and long-term occurrence of old growth dependent species would be unlikely.**	**Similar to Alternative II, except the likelihood of long-term maintenance of old growth dependent species is improved over Alternative II.**	**Similar to Alternative II, except the likelihood of long-term maintenance of old growth dependent species is improved over Alternative III.**	Essentially the same as Alternative I.
Waters of the U.S. & Wetlands					
Wetlands & riparian zones	Wetland and riparian zones could be disturbed by timber sale roads and development of private lands.	**A total of 9.6 acres of Waters of the U.S. and wetlands would be disturbed by the project.**	**About 7.7 acres of Waters of the U.S. and wetlands would be affected.**	**Less than 6.6 acres of Waters of the U.S. and wetlands would be disturbed.**	**Similar to Alternative IV**.
		Functions and values may decrease until the 13.8 acres of Waters of the U.S. and wetland mitigation sites were established.	**Similar to Alternative II but only 10.5 acres of Waters of the U.S. and wetland mitigation sites have been identified.**	**Same as Alternative III.**	**Similar to Alternative II but only 7.0 acres of wetlands mitigation sites are proposed.**
Transportation					
Public access	Public access for hunting, fishing, hiking and other recreational activities would remain the same.	There may be delays and temporary road closures during road construction and reconstruction.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II.
		N/A	FDR No. 150B between Engle Creek and Government Mountain Road west would be restricted to mine-related traffic.	Same as Alternative III.	FDR No. 150B would be closed during operation between Engle Creek and paste plant.
		Paving of FDR No. 150 and widening of FDR No. 2741 would improve year-round public access to the CMW and for general recreational activities.	Same as Alternative II.	Public access from FDR nos. 2741 and 150 above the confluence of the East and West forks of Rock Creek would remain the same as Alternative I.	Same as Alternative I.
Public access (Cont)		Close 4.81 miles of road (1.88 mi. of FDR No. 2741-Chicago Peak Rd., 0.18 mi. of FDR No. 2741x and 2.75 mi. of FDR No. 2285-Orr Gulch Rd.)	Same as Alternative II but 3.67 miles - would close 1.61 miles of Orr Gulch Rd.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Traffic safety	Traffic volumes and accident risk would grow or decline with population changes, timber sales, and development of private lands.	The average daily traffic (ADT) for Montana Hwy. 200 would increase by 71 percent during construction and by 38 percent during mine operation. The ADT for FDR No. 150 also would increase by 2,800 percent and 1,440 percent, respectively. This would increase the chances for traffic-related accidents on these roads.	ADT would remain essentially the same as in Alternative II. Any carpooling and busing would reduce ADT.	Similar to Alternative III, except that ADT on FDR nos. 150 and 2741 above the confluence of the East and West forks of Rock Creek after evaluation was completed would be similar to Alternative I.	ADT on Hwy 200 would be the same as Alternative II with busing of mine employees. The ADT on FDR No. 150 would increase 1,100 percent over Alternative I during construction and 200 percent during mine operation. Above the mill site, the traffic would be similar to Alternative I.
	Traffic to Hereford rail siding and Government Mountain (FDR No. 150) would remain at existing levels.	Slow moving ore concentrate trucks travelling to and from the Hereford rail load-out would be turning onto and off the Montana Hwy. 200. This would create additional hazards to higher speed highway traffic and residential traffic at Hereford.	Ore concentrate truck traffic would be eliminated from Montana Hwy. 200. ADT on FDR No. 150B from Engle Creek to the Miller Gulch rail load-out would show a slight increase.	Same as Alternative III.	Ore concentrate would be slurried from mill to rail loadout thus eliminating the need for concentrate trucks.
		Road alignment of FDR No. 150 and MT Hwy. 200 intersection could increase potential for accidents.	FDR No. 150 and Montana Hwy. 200 intersection location complies with state standards and would not increase potential for accidents.	Same as Alternative III.	Same as Alternative III.
Aesthetic Quality					
Noise	Existing noise levels in the Rock Creek drainage and Clark Fork Valley would be maintained except for changes associated with timber sales and private land development.	Long term noise-related impacts to mountain goats (see above).	Long-term impacts to mountain goats would be somewhat reduced (see above).	Similar to Alternative III.	Same as Alternative III.
		Blasting during adit construction would generate sounds up to 125 dBA within 900 feet of the blast and 60-80 dBA within the Clark Fork Valley and the CMW. Construction equipment would generate sounds up to 110 dBA within 50 feet.	Similar to Alternative II except that sound mitigations to construction equipment could reduce noise levels.	Same as Alternative III except that moving the mill to the confluence would increase the buffer between the mill/mine operations and the CMW to 1.25 miles. Noise levels would be about 35 dBA at the CMW boundary.	Same as Alternative IV.
		Mine operation noise levels of 52-62 dBA are lower than construction noise levels but still greater than premine conditions and would generally be inaudible in Clark Fork Valley.	Implementation of sound mitigations (e.g. reduce backup beeper volumes, dampen exhaust and intake fan, and retain vegetative buffers) would reduce operation noise levels.	Same as Alternative III.	Same as Alternative III.
		Traffic related noises would significantly increase on FDR No. 150 from 30 to 70 dBA.	**Similar to Alternative II.**	**Similar to Alternative II.**	Busing of mine employees would reduce traffic frequency by 72 percent compared to Alternative II. This would in turn reduce the frequency of traffic-related noise.
Noise		**Activities at the Hereford rail load-out facility would generate noise up to 87 dBA daily between 8 a.m. and midnight. This would increase noise levels to residences in the area.**	Noise-related impacts to Hereford residences would be avoided by moving the rail load-out to the Miller Gulch site. Sound levels at Miller Gulch would be similar to those at Hereford (Alternative II), but there are no nearby residences that would be impacted.	Same as Alternative II.	Same as Alternative II.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
		Ventilation fans would operate continuously at about 123-96 dBA and would be heard at about 45 dBA up to a mile away (450 acres) for the last 15-20 years of mine operation. This would significantly affect the solitude expected by people visiting the area of the CMW near the adit.	Relocation of the ventilation adit and sound mitigations for the ventilation fans would reduce the noise level to 30 dBA within 100 feet of the adit, and effect an estimated 12 acres. This reduces the impact to CMW visitors.	Same as Alternative III.	Same as Alternative III.
Scenic quality	Visual character of the Rock Creek drainage and the Clark Fork Valley would be retained.	**Significant impacts to Rock Creek drainage and Clark Fork Valley from project features during construction and operation.**	**Significant impacts somewhat reduced by painting or staining mill facilities and immediate revegetation of cut slopes and waste rock dumps.**	**Similar to Alternative III except impacts at confluence mill site further reduced by visual buffer along FDR No. 150 and immediate revegetation of mill pad face following construction.**	**Same as Alternative IV.**
		Impoundment visibility would significantly impact travelers on MT Hwy. 200 due to lack of screening and postponement of planting trees until after mine closure and topographic changes.	Impoundment visibility along MT Hwy. 200 reduced by planting vegetative screen and concurrent planting of trees and shrubs after year 7 of impoundment construction.	Same as Alternative III.	Paste facility visibility along Montana Hwy. 200 reduced by vegetative screen. Phased reclamation of deposit incrementally reduces deposit visibility, but effectiveness varies with deposition options.
		Impoundment surface highly visible in background for CMW users on high trails and peaks.	Similar to Alternative II, but long-term visibility reduced due to changes in revegetation plan.	Same as Alternative III.	Same as Alternative III.

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TABLE 2-18 (Continued)
Summary Comparison of Project Alternatives Impacts[1]

ENVIRONMENTAL ISSUE	PROJECT ALTERNATIVES				
	I (No Action)	II (ASARCO's Proposal)	III (Project With Mitigations)	IV (Modified Project With Mitigations)	V (Paste Facility)
Scenic Quality (Cont.)		Utility corridor visible to people using FDR No. 150.	Similar to Alternative II.	Similar to Alternative II.	Similar to Alternative II but pipelines buried except at stream crossings.
	Forest Plan Visual Management System (VMS) and Visual Qualtiy Quality Objectives (VQO) would be used for future timber sales or other KNF management activities.	**The proposed VMS VQOs would be impossible to achieve during mine life and/or VQO time frames.**	**Same as Alternative II.**	**Same as Alternative II.**	**Same as Alternative II.**
		The impoundment surface could potentially never meet Retention VQO standards.	**Additional reclamation requirements would increase the likelihood the impoundment surface would achieve VQO standards within several decades.**	**Same as Alternative III.**	**Same as Alternative III.**
		The impoundment face, mill site and utility corridor might achieve prescribed VQOs several decades after mine closure.	**Additional plantings for screening, concurrent planting of trees and shrubs on impoundment face after year 7 of construction, and other additional reclamation requirements would shorten the amount of time needed for mine facilities to achieve VQO standards, but it would still take decades.**	**Similar to Alternative III, except that the elimination of the waste rock dump, immediate planting of the mill pad face, and the visual buffer would further help the site achieve VQO standards after several decades.**	**Same as Alternative IV.**
Wilderness	Current wilderness experience remains unaffected.	**The wilderness ventilation adit would be highly visible and audible to recreationists using the CMW within 2,500 feet of the adit. The adit would significantly affect the wilderness experience of those users (see Noise above).**	Placing the ventilation adit in a more vertical slope could increase its visibility, but would reduce the area of disturbance around the adit. Additional reclamation requirements would dramatically reduce the visual impacts of the adit after mine closure.	Same as Alternative III.	Same as Alternative III.
			Sound mitigations would reduce the noise-related impacts to humans and goats to a 100-foot radius around the adit.	Same as Alternative III.	Same as Alternative III.

[1] All significant or potentially significant impacts are in **bold text**. For more detail, see Chapter 4.

be determined at this time. Water draining from the adits would drain into the mine waste at the mill site and into the alluvium beneath it and then possibly into Rock Creek.

Prediction of the precise hydrogeologic effects of mine development within a fractured bedrock aquifer is extremely difficult even numerous monitoring wells are available and the subsurface geology is well known. Nevertheless, the typical impacts of such mining activities are well-understood and are described below.

Void spaces created by underground mining tend to interconnect previously isolated fractures and faults. Prior to mining, some of these structures would have been conduits for groundwater while others would not have been connected to sources of recharge and would therefore have been dry or would not have been paths of significant flow. Mining can drain fractures, possibly resulting in loss of flow at pre-existing springs, and can also re-direct water into previously dry fractures, resulting in the formation of new springs. The locations of underground fractures and their relationships to surface features such as springs is frequently impossible to determine prior to mine development. Therefore, effects on springs and seeps cannot be predicted precisely.

With the Rock Creek ore deposit, these factors of uncertainty are compounded by the deposit's location. Monitoring wells cannot be drilled into the deposit as the lands above are wilderness. Even if it were possible, drilling monitoring wells at the site would require an unreasonable amount of disturbance and environmental destruction due to the topography (very steep slopes and rock faces) above the deposit. Additional hydrogeologic data will become available during development of the exploration adit. Even without such data, however, it can reasonably be predicted that mining could reduce flows at some springs (mostly above the ore deposit) and will likely increase flows at other springs downgradient of the deposit.

Construction of the mill pad, roads, and waste rock dumps would temporarily increase the concentrations of sediment and nitrogen loads of Rock Creek for alternatives II and III. The concentration of total suspended solids probably would not increase more than 7 mg/L (see **Chapter IV, Hydrology**). The concentration of nitrogen cannot be estimated with certainty and would depend upon the amount of nitrogen contamination of the waste rock, climate, infiltration beneath the mill pad, starter dams, and waste rock piles, and amount of surface runoff circumventing containment barriers and diversion structures. Aquatic invertebrates could be significantly impacted from increased nitrates in the short term. Impacts to aquatic plant communities or algae would be potentially significant in the short term from increases in nitrogen. Alternative III mitigations would reduce sediment loads in Rock Creek lessening the impacts to aquatic life. For alternatives IV and V, suspended sediment produced from construction of the mill facility, and residual nitrogen from blasting would not affect the West Fork Rock Creek because the mill would be located farther downstream, there would be less road construction/reconstruction, and there would be no waste rock dump. The 300-foot stream buffer around the confluence mill site would further reduce sediment impacts to lower reaches of Rock Creek under alternatives IV and V. A sediment abatement effort on 114 acres of Rock Creek and/or Bull River watersheds in Alternative V would offset expected short-term sediment effects.

Impacts to aquatics and fisheries from spills and/or pipeline ruptures would be potentially significant for all action alternatives. The potential for spills to reach surface waters would be somewhat reduced due to consolidation of utility and road corridors and the relocation of the lower portion of FDR No. 150 away from Rock Creek. The potential for spills and rupture would be further reduced by burial of the pipelines under Alternative V. Relocating the mill to the confluence of the East and West forks of Rock Creek under

Alternative IV and V would eliminate the potential for materials from spills and pipeline ruptures to reach the West Fork Rock Creek.

Changes in ground water quality for all four action alternatives would, for the most part, be restricted to an approved ground water mixing zone that must be approved by DEQ. Under all action alternatives, only nitrates and dissolved manganese would exceed Montana's standards (manganese exceeds the standard in ambient ground water) within the mixing zone. Clays removed for dam stability purposes in alternatives III and IV would be used to seal higher permeable areas such as the colluvium at the north end of the impoundment. An engineered perimeter drain and ground water extraction well system would collect and pump seepage back to the tailings impoundment and prevent changes in ground water quality outside of the mixing zone for alternatives II through IV. Discharge of tailings impoundment seepage to Rock Creek, Miller Gulch, and the Clark Fork River would be nearly eliminated. Frequent monitoring from associated compliance wells would be required to determine the effectiveness of the system and whether or not additional pump-back wells would be needed for alternatives II through IV or whether a pump-back system needs to be added for Alternative V.

ASARCO's water monitoring plan would be expanded for alternatives III through V and would include a Monitoring Alert Levels and Contingency/Corrective Action Plan. This plan would ensure early detection of potential environmental degradation or impairment and would focus primarily on the protection of surface and ground water resources. The intent of this additional plan would be to prevent pollution and other problems before they occurred. The water monitoring plan would be coordinated with the fishery/aquatics monitoring plan and wetlands mitigation and monitoring plans.

Surface and Ground Water Quantity. Surface water runoff in Miller Gulch would decrease during the life of the project but would not impact downstream users. It likely would return to near normal levels after reclamation was complete and when surface water on the impoundment could be discharged into the drainages. The decrease in runoff cannot be quantified but would be greatest during spring runoff.

No impacts to streamflows in Rock Creek or the Clark Fork River would occur for any alternative. There would be some reduction in ground water flows down gradient from the impoundment due to the extraction wells for alternatives II through IV. Once the impoundment seepage and ground water quality under the impoundment returned to premine water quality levels, the extraction wells would be turned off. This would allow ground water flows to return to premine levels. Impacts to groundwater flows under Alternative V would be negligible unless a pump-back system becomes necessary.

Wilderness Lakes and Wetlands. ASARCO would leave a minimum of 100 feet of overburden between mine workings and the ground surface. In the vicinity of Copper and Cliff lakes, in excess of 900 feet of overburden exists. Given this thickness of overburden and the inherent strength of the rock, the potential for fracturing and subsidence are extremely remote. Regardless, rock mechanics data from the evaluation adit and mined areas would be required for alternatives III through V. These data would be used for the Agencies' evaluation and approval of updated mine plans prior to mining near the lakes. Impacts to wilderness lakes, wetlands, and associated aquatic life from subsidence would be potentially significant for all action alternatives although the potential for subsidence would be extremely remote.

A contingency plan would be developed to mitigate impacts to the lakes and any associated wetlands to comply with the 404(b)(1) permitting process.

Changes to Wildlife, Habitat, and Threatened and Endangered Species

Grizzly Bears. The proposed project would physically alter habitat due to the construction of mine facilities (585 acres under Alternative II, 609 under Alternative III, 542 under Alternative IV, and 483 under Alternative V). Additional habitat effectiveness would be significantly reduced due to increased human activity. The reduced habitat effectiveness would be greatest during the construction phase; Alternative II would impact the greatest area (8,196 acres) and Alternative V would impact the least area (7,044 acres). Reduced habitat effectiveness would be less during mine operation; Alternative II would impact 7,308 and Alternative V would impact 6,428 acres.

The increased mortality risk from vehicle-bear collisions, poaching and destruction of nuisance bears could reduce the existing grizzly bear population. Behavior of bears whose territories include the permit area could be modified. Bears could be displaced, feeding patterns could be disrupted, and breeding success interfered with.

The existing Forest Plan standards for grizzly bear management on the KNF have been designed to provide the necessary components for a recovered grizzly bear population across the Cabinet-Yaak ecosystem (a minimum mortality risk, adequate food supply, spatial distribution of habitat and grizzly bears). The existing bear management standards are not being met in Rock Creek and the adjacent area and thus the area is not meeting the requirements for recovery of grizzly bear. The proposed project would result in a further decrease in the grizzly bear standards for Rock Creek and the surrounding area.

The recent bear management approach has been to restrict vehicle use on 6.9 miles of road in the Rock Creek drainage. An additional 4.81 miles (Alternative II) or 3.67 miles (alternatives III through V) would need to be closed to meet the 0.75 miles of open road per square mile standard for bear analysis areas. These additional road closures, stemming from the proposed project impacts, would not eliminate the impacts nor reduce the significance of the impact on bear recovery. The project would narrow the north-south movement corridor along the Cabinet Mountains resulting in a fragmented recovery area. The result is a potential delay in the recovery of the grizzly bear in the Cabinet-Yaak ecosystem due to the proposed project. The significance of the impacts is based not only on the need to minimize effects but on the mandate of the Endangered Species Act to "conserve and recover" the species. Mitigation would be phased in over the start-up period and be in place by the start of full operations. Mitigation may not prevent incidental taking; therefore, the action alternative may adversely affect the grizzly bear.

Other Threatened and Endangered Species. The increased risk of road-killed deer would increase the potential for vehicle collisions with feeding bald eagles along Montana Highway 200 and the railroad. The potential to lose a member of the existing bald eagle pair using the lower Clark Fork Valley would delay and thus significantly affect recovery of the species in this area. Mitigations for alternatives III through V include removal of road-killed deer from road rights-of-way. This, in conjunction with busing employees and eliminating the trucking of concentrates, would significantly reduce potential impacts to bald eagles.

Migrating peregrine falcons would continue to use the Clark Fork drainage.

Although there are no confirmed sightings of gray wolves within the Rock Creek drainage, suitable habitat would be destroyed and/or rendered ineffective by proposed project activities for all action alternatives. The level of significance cannot be determined at this time.

Big Game Animals. All action alternatives would cause disturbances that could displace big game (deer, elk, moose, and black bear) during part of or all of mine life. Some big game habitat, including travel corridors, riparian areas and a few small bull elk wintering areas, would be altered or destroyed due to construction of mine-related facilities. The increase in traffic, particularly along FDR No. 150, would result in more animal-vehicle collisions. Due to increased human knowledge and use of the area there likely would be more hunting and poaching pressure. Alternatives III through V mitigations would reduce some habitat loss and disturbance, but the overall effects could be similar among all action alternatives. Reclamation plans (see Appendix G of the draft EIS) for alternatives III through V would be designed to avoid attracting big game during mine life to help reduce potential problems from big game interfering with reclamation and to avoid creating a mortality risk for the animals. The increased use of native plant species would help achieve the long-term reclamation goal for wildlife habitat restoration.

Neotropical Migrant Birds. The loss of older forests (including old growth habitat) and riparian habitats (alternatives II through IV) would affect neotropical migrant birds (birds that seasonally migrate from tropical areas such as Mexico to North America). Habitat would be converted primarily to open grass communities, disturbed sites (such as borrow areas and tailings impoundment), or artificial areas (such as roads and buildings). Reclamation plans for alternatives III through V would create a more diverse vegetative habitat that would better replace lost or disturbed habitat than under Alternative II.

Sensitive Animal Species. All action alternatives could have significant to less than significant impacts on some sensitive species in the short or long term. Alternative I would have the least impact; although the development of ASARCO lands along Rock Creek if the company sold its lands, could have significant impacts on the harlequin duck. The action alternatives would generally decrease in impact from Alternative II through Alternative V. Indirect effects from increased human development in the surrounding Lower Clark Fork and Bull River valleys would be the most significant, unavoidable impact to most species considered.

The most significant impact would be to harlequin ducks in Alternatives II, III, and IV, where the alternatives were determined to trend the species towards federal listing under the Endangered Species Act. Alternative V incorporates adequate mitigation to prevent or avoid impacts such that this trend would not be expected to occur. The impacts to harlequin ducks would be from disturbance from mine-related activities, habitat loss or alteration, water quality impacts, and the risk of a hazardous material spill. Indirect impacts as noted above would also affect harlequins, particularly along the other streams of the Lower Clark Fork subpopulation.

While fisher habitat would be reduced, fisher habitat is widespread on the Kootenai National Forest. Lack of available suitable habitat does not appear to be limiting to fishers. The habitat loss and increase in mortality risk decreases in impact from Alternative II to Alternative V. The most important key habitat, old growth, is not measurably affected in Alternative V. Mitigation features incorporated into Alternative V would reduce impacts to less than significant. All action alternatives were determined to potentially impact individuals but not trend the species towards federal listing under the Endangered Species Act.

Lynx habitat would not be significantly affected in any alternative, and none of the alternatives were expected to have a measurable impact on lynx. Mortality risk due to increased trapping pressure may occur; this is under management control should impacts be considered unacceptable in the future. Indirect effects of increased human development attributable to the project may decrease the ability of the low elevation Noxon area to be used as a long distance dispersal corridor. However, the corridor is currently significantly

compromised from existing human developments and the incremental decrease in effectiveness of the corridor attributable to the project's effects are probably negligible.

Wolverine habitat would not be significantly affected in any alternative. Because wolverine are wide-ranging animals, the indirect impacts of increased disturbance and increased human development may increase mortality with all action alternatives. Mitigation proposed for grizzly bear would likely be effective in reducing the impacts of disturbance and increased mortality risk, and alternatives with mitigation proposed for grizzly bear would be the least impactive action alternatives. The effects of all the action alternatives were determined to possibly impact individual animals but not trend the species towards federal listing under the Endangered Species Act.

The increased traffic levels along FDR No. 150 may very slightly increase traffic-related mortality risk to Coeur d'Alene salamander. This level of mortality risk is unlikely to reduce viability for this species because the likelihood of occurrence is considered extremely remote. The action alternatives were determined to possibly impact individuals but not trend the species towards federal listing. Of the action alternatives, Alternative V has the least risk because of decreased mine-related traffic.

None of the other sensitive species analyzed were determined to be measurably impacted by the project.

Sensitive Aquatic Species. All action alternatives would impact resident populations of bull trout and westslope cutthroat trout in Rock Creek. These impacts would be the result of increased sediment loads from road construction and runoff. Rock Creek already has a high level of fine sediment, close to critical levels, in available spawning gravel. Increased sedimentation would significantly reduce fry emergence and potentially would lead to elimination of these fish populations due to spawning failure. Since Rock Creek and Bull River are the two major spawning areas for the Cabinet Gorge bull trout populations, degradation of the Rock Creek bull trout spawning habitat would significantly impact Cabinet Gorge bull trout.

Alternatives II and III would impact spawning habitat and resident fish populations the entire length of Rock Creek from the upper mill site to the Clark Fork River. These two action alternatives could have the greatest potential impact to the Cabinet Gorge bull trout populations. However, under alternatives III through V, the identification and reduction of existing sediment sources in the Rock Creek and the Bull River drainages by ASARCO prior to mine construction would help offset short-term increases in sediment due to facility construction. The possible reduction of sediment sources in spawning streams in the Bull River drainage could improve bull trout populations and viability in those streams. These mitigations could reduce project-related impacts to the Cabinet Gorge Reservoir bull trout population. Other mitigations, such as construction-BMP monitoring also would help reduce sediment impacts to sensitive aquatic species under alternatives III through V.

Moving the mill site to the Rock Creek confluence (alternatives IV and V) eliminates project-related impacts to populations of bull and westslope cutthroat trout in the West Fork Rock Creek as well as reducing sediment impacts to spawning habitat and fish populations in Rock Creek below the confluence with its East Fork. Impacts to the Cabinet Gorge bull trout populations would be further reduced. Sediment mitigation on 114 acres of Rock Creek and/or Bull River watersheds would benefit all sensitive fish in the long term.

Under Alternatives II, III, and IV, catastrophic failure of the tailings impoundment could result in an irretrievable loss of sensitive aquatic species, particularly resident fish species. The risk of catastrophic failure would be greatly reduced by using paste technology.

Plant Species of Special Concern. All action alternatives would disturb or eliminate nine to eleven populations of four plant species of special concern. Field verification of population locations would be conducted during field road alignment (to finalize road layout and design) for all action alternatives. Minor road alignment changes could result in avoiding some sensitive plant species populations.

Mountain Goats. All action alternatives could result in a decline in the Rock Peak goat herd due to increased disturbance, mortality risk and loss of habitat effectiveness. Disturbance could stress goats leading to declining health and reproductive vigor. Disturbances could displace some goats from their habitat. Displaced goats also would suffer higher stress levels.

Mine-related disturbance would reduce habitat effectiveness on up to 992 acres during construction and up to 530 acres during operation (see **Table 4-20**). Noise mitigations proposed under alternatives III, IV, and V would substantially reduce noise and related impacts around the wilderness ventilation adit which is located in important summer habitat. Road closures proposed for several alternatives would result in an increase of habitat effectiveness of up to 238 acres during the operations phase.

Increased access and human recreational use of the area also would increase disturbance and mortality risk. Goat mortality due to poaching and hunting would likely increase as a result. Road closures for grizzly bear mitigation would reduce these impacts.

Impacts on the Rock Peak herd would be compounded when impacts from Noranda also are considered. The shifting of animals out of the Rock Creek and Ramsey Creek drainages into the CMW from either side could increase the stress of the displaced animals. It also could increase the use of unaffected summer ranges creating potential conflicts with resident goats in the CMW.

Pileated woodpecker. Alternatives II, III and IV would have a potentially significant effect on local populations of the pileated woodpecker. This impact would be caused by direct habitat loss or reduced habitat effectiveness on 122 to 30 acres (alternatives II to IV, respectively). The anticipated small stand size, lower habitat quality, and limited quantity of habitat would affect sustainability of local populations. Alternative V would not measurably affect pileated woodpecker habitat.

Impoundment/Paste Facility Stability

Tailings would be disposed in an impoundment located just west of the lower reach of Rock Creek under alternatives II through IV. Conceptual impoundment designs were developed assuming a 7.0 earthquake along the Bull Lake Fault 16 miles away. Under Alternative II, ASARCO proposed constructing the impoundment using the upstream method. The modified design for alternatives III and IV specifies the centerline method for 7 years and the upstream method for the remainder of mine operation. The modified design also would include compacting the tailings beach, possible removal of soft clays under the starter dams, and constructing a concrete shear wall under one of the starter dams to reduce the risk of impoundment failure. Although either impoundment design would be subject to review and approval by the Agencies, the modified design for alternatives III and IV also would be subject to a technical panel review including a review of a feasibility study on the use of alternative methods to reduce seepage. Failure of the

impoundment, while a remote possibility, would have a significant impact to surface waters and aquatics/fisheries.

Alternative V incorporates paste technology as the tailings management option. Under this alternative, the tailings would be dewatered to approximately 20% water by weight (vs. approx. 50% by weight under Alts. II-IV), resulting in a material similar in consistency to stiff cement. The paste tailings would be placed via a pipeline system starting either near the perimeter of the proposed impoundment footprint (Bottom-Up approach) or near the top of the final estimated impoundment height (Top-Down approach). The final configuration of the tailings embankment would be achieved through working the slopes with machinery to achieve the desired aesthetic result. The paste is capable of receiving this kind of reworking due to its lower overall moisture content and resulting higher strength characteristics. In addition to having increased strength, the paste also has a higher viscosity than the "wet" tailings in Alternatives II - IV. The paste then has less tendency to flow when it is not contained, and hence a failure of a paste slope would not result in the kind of tailings run-out which could be expected from a "wet" impoundment. While the likelihood of failure of a paste impoundment is considered negligible (less than 1 in 1 million chances of occurring), there would be an impact to surface waters and aquatics/fisheries should the paste reach a water source. This impact has been defined as having a short term irreversible impact and a long term excursion of water quality. The final design for the tailings paste facility would be subject to a technical panel review as required for the impoundment under alternatives III and IV.

Changes in Socioeconomics

Employment. The development of this project would result in a significant boom-bust employment cycle with a peak employment of 433 construction and 355 mine operation workers for alternatives II and III. The additional construction time required for alternatives IV and V (3 years compared to 1.5 for alternatives II and III) would reduce the peak construction work force to 350 workers but impacts would still be moderate to major. About 140 to 150 indirect jobs would be generated for alternatives II through V. Approximately 50 percent of the construction workers and 80 percent of the mine operation workers would be hired locally.

Population. Sanders County would experience a population increase of approximately 4 percent and Bonner and Lincoln counties populations would increase by less than 0.4 percent during mine construction (a total of 483 people). This would drop to less than a 3 percent increase for Sanders County and a 0.15 percent increase for Bonner and Lincoln counties during mine operation (a total of 227 people). Alternatives IV and V would reduce the peak construction-related population influx to 380 people. This could result in significant impacts on Sanders County and city services (see **Community Services**). Population increases associated with the Montanore Mine would be primarily in Lincoln County, so there would not be significant cumulative project impacts to Lincoln County.

Income. All action alternatives would generate approximately $9.6 million dollars of annual personal income and indirectly stimulate an additional annual income of $1.5 million in the three-county area. This would have a minor (2 percent) impact on the area's personal income.

Housing. Housing, especially rental units, is already limited in the project vicinity. Demand for rentals during mine construction would be expected to create a housing shortage. A moderate-sized mobile home court or an apartment building would be expected to be developed to meet these needs. New home construction probably would increase once the mine began operating and long-term residences would be

needed for mine workers. Increased housing costs may impact people on fixed or low incomes. After mining operations ceased, there might be a surplus of houses in the area.

Community Services. ASARCO's Hard Rock Impact Plan[3] has been developed and identifies how financial mitigations for impacts to local government services would be implemented. The plan would provide relief needed to mitigate the fiscal impacts to direct local government services identified for any action alternative.

The increase of students (total of 63 elementary and 29 high school students) during mine construction may exceed classroom capacities and school accreditation standards in Sanders County (41 elementary and 19 high school students). Since this temporary increase would end after approximately 1.5 to 2 years, local schools may decide to maintain current educational quality by hiring additional teachers rather than increasing class sizes. A total of 63 new students (44 in Sanders County) would be enrolled during mine operation.

Rapid immigration and increased mine traffic could result in the need for additional law enforcement, including Montana Highway Patrol personnel, and fire protection personnel.

Community water facilities in Noxon and Heron are near capacity. Impacts to ground water resources for private wells cannot be determined at this time. Thompson Falls sewage treatment facility is near capacity and would not be able to accommodate additional demands.

Fiscal. This project would generate direct increases in property tax revenue to local governments; this would peak at about $600,000 for Sanders County during the second year of production. Additional revenues would be generated by the Gross Proceeds Tax and the Metal Mines License Tax (estimated to be a maximum of $300,000 in Sanders County). Increases in personal property and income taxes would occur as a result of increased employment, personal property taxes, and purchase of local services and merchandise. ASARCO's Hard Rock Impact Plan would allocate these tax revenues to more closely match the timing and scope of increased local demands for government services (see above). This plan has been negotiated between ASARCO and the local governments (see **Chapter 1** and Alternative V description in **Chapter 2**).

Land Use. All action alternatives would restrict the potential land uses (especially residential, commercial, and industrial uses) of about 400 acres at the impoundment site. Minor land use changes would be associated with new mine-related housing and commercial development. The acquisition of land or placement of conservation easements for grizzly bear mitigation would restrict future residential and commercial development on about 3,074 acres for Alternative II, 2,692 acres for Alternative III, about 2,536 acres for Alternative IV, and 2,350 acres for Alternative V.

Changes in Old Growth Ecosystems

Effective Old Growth Habitat. Alternatives II through IV would destroy old growth or render it less effective. Alternative II would affect a total of 122 acres; Alternative III, 47 acres; and Alternative IV, 30 acres. Because of closure of some open roads, Alternative V would result in a slight increase in habitat effectiveness by one acre. Mining-related disturbances would fragment stands below 25 acres and create

[3] Submitted June 23, 1997, and approved October 23, 1997.

more edge effect in larger stands. The percent of biologically effective habitat would be below the 8 to 10 percent needed to support old growth dependent species under alternatives II through IV. Pileated woodpeckers, goshawks, and fishers are among old growth associated species that would be affected by this loss. A potentially significant decline in species diversity could result under the action alternatives that reduce old growth.

Changes in Waters of the U.S. and Wetlands

All four action alternatives would fill Waters of the U.S. and wetlands (see **Table 2-6**). The tailings impoundment footprint would directly and indirectly impact the same total amount of wetlands for all action alternatives. The Alternative V construction of the paste tailings impoundment panels phased-in throughout the 34-year project would delay the direct and indirect impacts to the wetlands, particularly those located directly under the impoundment. The location of the mill site and waste rock dump and the alignment of FDR No. 150 determines the total amount of wetlands and Waters of the U.S. impacted by each alternative. Alternative II would impact a total of 8.1 acres of wetlands and 1.5 acres of Waters of the U.S. Alternative III would impact a total of 6.2 acres of wetland and 1.5 acres of Waters of the U.S.; and Alternative IV would impact a total of 6.2 acres of wetland and 0.4 acres of Waters of the U.S. Alternative V would also impact a total of 6.2 acres of wetlands and 0.4 acres of Waters of the U.S. These would be significant impacts.

Temporary indirect impacts to Waters of the U.S. and wetlands would occur during construction of roads and the mill pad due to increased sediment contributions. Proposed BMPs would reduce sediment contributions. Alternatives II and III would have temporary impacts at specified locations along Rock Creek from the confluence of the East and West Forks to the Clark Fork River. Alternatives IV and V primarily would have indirect impacts below the confluence of the East Fork Rock Creek. Very few indirect impacts would be associated with the evaluation adit other than the reconstruction of FDR No. 2741. Alternative V would have nearly the same total acreage of indirect impacts as the other action alternatives, but the timing of the impacts would be delayed throughout the 34 year project with the past tailings construction.

ASARCO has identified 12.3 acres of wetland mitigation sites and 1.5 acres of Waters of the U.S. mitigation sites for Alternative II (see **Table 2-7**). Only 10.5 acres of the wetland mitigation sites would be available for alternatives III and IV due to the realignment of a segment of FDR No. 150. There are, however, potential sites within the floodplain along Rock Creek that could be identified and used for mitigation should the COE require additional mitigation areas. Alternative V would develop a total of 7.0 acres of wetland mitigation sites along Rock Creek and at the Miller Gulch site.

In addition, ASARCO has identified three optional wetland mitigation sites that could be developed if the proposed sites prove to be less successful than anticipated for replacing the lost wetland functions and values. All wetland mitigation sites would be developed as replacement wetlands prior to disturbance of the existing wetlands. The 1.1 acres of Waters of the U.S. at the upper mill site (alternatives II and III) would not be reconstructed until the mill site was reclaimed. The 0.4 acres of Waters of the U.S. along the FDR No. 150 and the utility corridor under all action alternatives would be temporarily impacted during construction. The primary functions and values of the created wetlands would be to re-establish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek, and attenuate peak flows. A temporary but potentially significant decrease in some of the wetland functions and values could occur until the created wetlands were revegetated and fully established.

Changes in Transportation

Public Access. All action alternatives propose both new road construction and road reconstruction. These activities would create traffic delays and temporary road closures. A traffic management plan would allow private landowners reasonable access to their property and public access to NFS lands.

Alternatives II and III would include a bypass around the West Fork mill site to allow access to FDR nos. 150 and 2741 above the mill. However, public access through either mill site or on the mine portal access road (all alternatives) would be restricted. Alternatives III through V would also restrict public traffic on FDR No. 150B around the impoundment.

The paving and widening of FDR No. 150 and upgrading of FDR No. 2741 would improve access to the CMW and for general recreational activities in the drainage. However, closure of 1.88 miles of FDR No. 2741 (Chicago Peak Road) and 1.6 miles of FDR No. 2285 (Orr Gulch Road) would result in longer hikes into the CMW from the end of the roads (see **Recreation and Wilderness**). Indirect impacts to some wildlife species would be created by increased accessibility for hunting, trapping and poaching (see Big Game Animals, Sensitive Animal Species, and Mountain Goats). FDR No. 150 above the confluence mill site would not be paved for Alternative IV or V although minor improvements to FDR nos. 150 and 2741 would occur for access to the evaluation adit; therefore, public access on those roads would remain similar to Alternative I.

Traffic Safety. The proposed project would generate increased traffic on FDR No. 2741 during evaluation activities and on Montana Highway 200 and FDR No. 150 during mine construction and operation for all action alternatives. Alternatives II and III also would increase traffic on the lower portion of FDR No. 2741 during mine operation. Routing ore concentrate haulers along Montana Highway 200 to the Hereford rail load-out would create the potential for increased traffic accidents. Ore trucks would be traveling at slower speeds than general traffic and would be turning across the highway going to and from the load-out. Alternatives III and IV route the concentrate trucks along reconstructed FDR No. 150B at the base of the impoundment to the Government Mountain Road and the Miller Gulch rail load-out. This would eliminate conflicts between ore trucks and general traffic on the highway. Alternative V eliminates the need for concentrate haul trucks since the concentrate will be piped. Restricting public use of FDR No. 150B also would avoid conflicts on that portion of the haul route. Relocation of the rail load-out to Miller Gulch eliminates potential confrontations, including accidents, with residential traffic at Hereford.

Alternative II's proposed road alignment for the intersection of FDR No. 150 and Montana Highway 200 does not meet highway standards for sight distance, increasing the potential for accidents with turning traffic. Alternatives III through V would relocate the road intersection to comply with the standards.

Changes in Aesthetic Quality

Noise. All action alternatives could create significant long-term noise-related impacts to mountain goats and their key summer habitat (see above). These impacts would be associated predominantly with the evaluation adit and the wilderness ventilation adit. Sound mitigations at the ventilation adit would minimally reduce the impacts. Alternative IV and V may also affect critical winter range at Rock Creek Meadows should loud noises, such as blasting, reach the winter range.

Blasting during adit construction would generate noise up to 80 dBA in the CMW and the Clark Fork Valley. While general mine operations would not be audible in the Clark Fork Valley, the operation of heavy equipment at the impoundment site would be audible in adjacent areas. Activities at the Hereford rail loadout

(Alternative II) would significantly increase noise levels to residences in the area. Relocation of the loadout to Miller Gulch would eliminate that impact and place the noise in a less populated area.

Recreationists using the Rock Creek drainage and FDR nos. 150 and 2741 would be able to hear mine and mill operations when within a mile of the facilities. Traffic related noise on FDR No. 150 would be increased significantly from 30 to 70 dBA. The level of the noise would be somewhat reduced in alternatives III and IV with the implementation of several noise mitigations and to an even greater extent under Alternative V.

Noise impacts to recreationists within the CMW would be associated primarily with the evaluation and wilderness ventilation adits and blasting and construction equipment noises (up to 80 dBA). Impacts from evaluation activities would be greatest during the first couple of years of mine activities; after that, noise would only be generated by ventilation exhaust fans. Sound from all adits would be audible (at 45 dBA) for approximately 1 mile away from the sites. The wilderness ventilation adit would only be in place and used during the last 15 to 20 years of mining. These sounds would negatively impact CMW visitors using nearby areas. Sound mitigations in alternatives III through V would reduce the fan noise to background levels (30 dBA) within 100 feet.

Scenic Quality. All four action alternatives would result in significant visual impacts for the Rock Creek drainage and Clark Fork Valley. Impacts would be associated with all features of the proposed project: the evaluation adit, the mill site, the mine portal and associated waste rock dumps, the ventilation adit (see wilderness below), the utility corridors and the tailings impoundment/paste facility.

The evaluation adit portal would be most noticeable from Government Mountain, though the impacts would diminish with distance. Lights from night operations would be visible in portions of the Clark Fork Valley. These visual impacts would be reduced in alternatives III through V. The waste rock dump would be revegetated to reduce contrast. Lights would be screened or baffled to reduce visibility across the valley.

The upper mill site in alternatives II and III would be highly visible to the public using FDR nos. 150 and 2741 but not visible from the Clark Fork Valley. The conveyor from the mine portal would create a strong linear feature that would contrast greatly with the natural landscape. The cut-and-fill slopes of the new mine access road for Alternative II would be visible for a long time. Under Alternative III, the new mine access road would not be built, reducing the amount of disturbance and visibility. The buildings would be painted or treated to reduce the amount of contrast.

The waste rock dump for Alternative II would be a prominent feature that would be difficult to revegetate and would remain highly visible for many years. The dump would be divided into two smaller dumps in Alternative III and graded closer to the natural slopes than was proposed in Alternative II. The dumps would be topsoiled and revegetated to facilitate reduction of visual impacts.

Alternatives IV and V would move the mill site to the confluence with the East Fork Rock Creek. A minimum 100-foot visual buffer would be left on either side of FDR No. 150 to provide screening. There would be no waste rock dump for this alternative as the rock would be used to build the mill pad and the impoundment starter dams or toe buttresses for the paste facility. The face of the mill pad would be reclaimed immediately after construction. Visual impacts from the confluence mill site would be potentially significant.

Either design of the impoundment or the paste facility would result in a large artificial form visible from several areas in the Clark Fork Valley. The size, form, color and texture of the tailings disposal facility would contrast dramatically with the surrounding landscape. The long-lasting effects would gradually be reduced as trees and shrubs were established. Reclamation of the impoundment face would be done concurrently throughout mine life for Alternative II. Trees and shrubs, however, would be planted after the face of the impoundment was completely reclaimed for Alternative II. Alternatives III and IV would require additional detailed regrading and revegetation plans to facilitate the mitigation of visual impacts. Reclamation, including the planting of trees and shrubs for alternatives III and IV, would begin after year 7 and would be concurrent until operations ceased. Trees would also be planted along Montana Highway 200 for screening as soon as Agency permits were approved. Under Alternative V, final reclamation would begin on paste surfaces when final grade was achieved with timing dependent on construction sequencing.

The proposed Visual Management System (VMS) Visual Quality Objectives (VQO) would not be achieved during mine life for all action alternatives. The impoundment surface potentially could never meet Retention VQO standards under Alternative II, but additional reclamation requirements under alternatives III through V would increase the likelihood that the standard could be achieved within several decades after final reclamation. Under Alternative IV and V, the elimination of the waste rock dump, immediate planting of the mill pad face, and the visual buffer around the confluence mill site would further help this site meet VQO standards. Although the facility sites could eventually achieve prescribed VQOs several decades after mine closure and final reclamation, the additional reclamation requirements would shorten the amount of time required, but it would still take decades.

Wilderness. There would be two types of impacts to users of the CMW: noise-related and visual. The noise-related impacts would be greatest during the construction and operation of the evaluation adit, construction of the mine adits and mine pad and the construction and use of the wilderness ventilation adit (see Noise). Mitigations under alternatives III through V would reduce these potentially significant impacts. Visual contrast of the impoundment surface would remain for alternatives II through IV due to its light color until completion of mine revegetation following mine closure. The phased reclamation of the paste facility would reduce its visual impact under Alternative V. The area of disturbance for the ventilation adit would be reduced in alternatives III through V by its relocation to a steeper site. Either location, however, is not in proximity to high use areas such as Rock, Saint Paul, and Moran lakes. Reclamation mitigations proposed under alternatives III through V would restore a premining appearance to the ventilation adit.

PART VI: THE AGENCIES' PREFERRED ALTERNATIVE

The Agencies' preferred alternative is Alternative V, modified Rock Creek Project with Mitigations. Alternative V would result in construction of the evaluation adit, mine, mill, tailings paste facility, rail loadout, reverse osmosis and passive biotreatment facility, and access roads. The Bottom-Up construction option would be used and final design would incorporate measures to meet visual impact mitigation and reclamation goals. Some water would be stored in underground workings and/or the tailings impoundment, but excess water would be discharged to the Clark Fork River after treatment. Environmental requirements in addition to those proposed by ASARCO would be incorporated to avoid and minimize (to the extent possible) or eliminate environmental impacts. Additional monitoring would help detect trends as well as unacceptable impacts, should they occur. Measures would be developed to respond to and control any unacceptable impacts that may be detected.

CHAPTER 3

AFFECTED ENVIRONMENT

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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 majority of the resources covered in this chapter have been condensed from the text in the draft EIS because no new information became available or analysis methods came into use since the publication of the draft EIS. The following resource sections, however, have been expanded in whole or part as described.

Forest Plan. *Use of GIS mapping has generated more accurate numbers.*

Geology. *The acid rock drainage discussion has been expanded.*

Hydrology. *Tables have been revised based on different more accurate and conservative methods of handling laboratory data.*

Aquatics/Fisheries. *New data collected on aquatic habitat characteristics and fish 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 1988. The USFWS proposal to list bull trout as a threatened species under the ESA necessitated preparation of a biological assessment for this species.*

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.*

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

Cultural Resources. *Additional input from regional Native American tribes collected regarding tribal history, historic use of area, and treaty information.*

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

impoundment and rail load-out. 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 includes 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, 1987-1994), 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 homeranges and effects differ in size and manner. Therefore, for some species, analysis area was greater or different than the original baseline study area. The largest study areas were for fisher, lynx 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. Most other species were analyzed within Compartment 711.*

Threatened and Endangered Species*. The area for grizzly bears include BMU 4, 5, 6, 7, 8, and 22. The bald eagle study area covers the lover Clark Fork and Bull Rivers. The peregrine falcon covers the Cabinet Ranger District. The area for wolves covers the north one-half of the Cabinet District.*

Socioeconomic. *The primary socioeconomic impact area for the proposed project is western Sanders County, along Montana Highway 200. Affected towns would include Noxon, Heron, and Thompson Falls. Affected school districts would include Noxon/Heron, Trout Creek, White Pine, and Thompson Falls. Some additional baseline information is presented for Lincoln and Bonner counties since these counties may receive slight socioeconomic spillover effects, particularly during project construction.*

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.*

FOREST PLAN DIRECTION

The Kootenai Forest Plan (U.S. Forest Service 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 amendments 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 (see draft EIS for MA definitions).

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 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.

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

FIGURE 3-1 - Location and Distribution of KNF Management Areas

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 1987-1994).

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 ASARCO'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 1987-1994). Wind measurements were not made at the proposed plant site.

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.

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 1987-1994.
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.

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.

[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

Geology and Physiography

The Rock Creek Project is proposed in the southeastern portion of the Cabinet Mountain Range. The area's topography is a function of the underlying rock types, structures (geologic faults and folds), and geologic history. The meta-sedimentary rocks are relatively strong and not easily erodible, but some of the sediments that accumulated in the lower portions of the Clark Fork River drainage during the last glacial period are much less stable.

The vast majority of the bedrock in the area consists of a meta-sedimentary rock sequence called the Belt Supergroup. Deposited in a subsiding basin 1,450 to 850 million years ago (Harrison 1972), the total thickness of the Belt Supergroup ranges from around 35,000 feet to over 50,000 feet. Muds, silts, sands, and carbonates were later altered under low-grade metamorphic processes to argillites, siltites, quartzites, and recrystallized carbonates, respectively. These rocks were later extensively folded and faulted along generally northwest-trending structures (Hayes 1983). More recently, glaciers sculpted the mountains and drainages, and plugged the area rivers. The Clark Fork River drainage was dammed with ice near the Idaho/Montana border. This dam formed Glacial Lake Missoula inundating the Clark Fork Valley with up to 2,000 feet of water. Lower portions of the Clark Fork drainage is now, in places, blanketed with lakebed clays and silts, sand, and gravel.

Mining History

Mining activity in this area dates back to the 1860s, and includes developments for gold, silver, lead, zinc, and copper. Major exploration for copper-silver stratabound deposits began in the early 1960s after the discovery of the Spar Lake deposit within the Revett Formation of the Belt Supergroup. Three large and several smaller deposits, and numerous small occurrences have been located — all within the Revett Formation and within the southwestern portion of the Kootenai National Forest. One deposit, the 64 million ton Spar Lake deposit (ASARCO's Troy Mine), began operation in 1981. Noranda Mineral Corporation's 135 million ton Montanore (Rock Lake) deposit was discovered in 1983 and permitted in 1993 (Noranda has not yet begun construction). ASARCO's Rock Creek deposit, recently redefined as a 136 million ton deposit, was discovered in the late 1960s. Three smaller deposits, peripheral to the Rock Creek deposit, continue to be claimed by Kennecott Exploration Co. Kennecott has not proposed development of these deposits.

Geology of Project Area

Rock Creek Ore Body

The Rock Creek deposit is approximately 16,000 feet long and 7,200 feet wide, and averages about 27 feet thick. The copper and silver ore is primarily contained in quartzite and to a lesser extent in siltite of the lower Revett Formation. Based on an updated analysis, ASARCO estimates that the deposit consists of 136 million tons of copper- and silver-bearing ore. The average ore grade is estimated to be 0.68 percent copper and 1.65 troy ounces of silver per ton.

Except for two outcrop areas and an area near Copper Lake, the rock overburden-to-ore body thickness ratio exceeds 15:1. Along the Copper Lake Fault, where it passes near Copper Lake, a portion of

the ore body increases to 100 to 150 or more feet thick. This portion of the ore body is 900 or more feet below the surface.

Mineral Zones

The Rock Creek ore body is centered within a larger mineralized zone as described below. Geologists have identified six zones, only two of which are of economic interest. Knowledge of the six zones has assisted in the overall exploration of this and other Revett-type deposits on the KNF and has assisted ASARCO in developing its mine plans. The six mineral zones and mineral abundances have also been observed and studied in the Spar Lake deposit (ASARCO's Troy Mine), Noranda's Montanore deposit, and Kennecott's three deposits. All exhibit virtually identical rock types and mineral assemblages of the Revett Formation.

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 is found only in these two copper sulfide zones and is found 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.

Surrounding the bornite-calcite and chalcocite-chlorite zones (the two zones that make up the ore body) are four additional but mineral zones that are not of economic interest. The two closest to the ore body are the chalcopyrite-ankerite and chalcopyrite-calcite zones - chalcopyrite is a copper/iron sulfide mineral. Surrounding these zone is the galena-calcite zone - galena is a lead sulfide mineral. And, surrounding this is the pyrite-calcite zone - pyrite is an iron sulfide mineral (Balla 1984). All mineralized zones will be penetrated by access and ventilation adits.

Acid Rock Drainage

When exposed to the right conditions, sulfide minerals are capable of weathering, or oxidizing. This process can release sulfuric acid and lower the pH of receiving waters. This is called acid rock drainage (ARD). The dilute acid is capable of leaching heavy metals from surrounding rock. This in turn contributes to lowering water quality and can be very damaging to aquatic systems. This is the driving issue behind the understanding of ARD potential. Conditions that control the rate of acid production are the presence of reactive sulphides, water and oxygen (the necessary ingredients), and oxidation catalyzing bacteria, pH, and temperature (Robertson and Broughton 1993). Pyrite is one of the most reactive of the sulfide minerals and particular attention is given to pyrite when testing for ARD potential.

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 cores I examined up through summer of 1983 [the last year of ASARCO's drilling of the deposit]

had mineral abundances 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.

According to Hayes' data, of the two zones which generally surround the ore body — that is, surrounding the bornite-calcite and chalcocite-chlorite zones — the chalcopyrite-ankerite zone contains "local trace" amounts of pyrite, while the chalcopyrite-calcite zone contains no pyrite. The galena-calcite zone contains a "trace" amount (less than 0.1 percent) of pyrite, while in the pyrite-calcite zone "...pyrite constitutes only an average of about 0.2 volume-% of the rock whereas the calcite constitutes an average of around 4%." Calcite is important; sufficient quantities of calcite, if available, would be capable of neutralizing some or all of the acid that might be produced.

All information indicates that the Rock Creek ore body and nearby rocks do not release detectable levels of sulfate when they weather naturally. Ore outcrops do weather, however, with resulting copper oxide mineral (malachite and azurite) coatings on the faces of fractures. All project area water quality data indicate neutral pH values. Results from ore body and waste rock static and kinetic tests are presented in **Chapter 4, Geology**.

Tailings Facility Area

The tailings storage facility area consists mostly of surficial materials overlying shallowly buried bedrock of the Wallace Formation. Bedrock is exposed to the surface in several small hills that are exposed through the surficial materials and on the slopes at the back (north) of the area (Dames and Moore 1993).

Most of the surface material is composed of silts and clays deposited by glacial Lake Missoula. Other alluvial deposits (sand and gravel) underlie and in places are interlayered with lakebed silts and clays. The depth of this unconsolidated material ranges from zero feet to over 85 feet. Clark Fork terrace alluvium (gravel) is exposed immediately adjacent to and south of the storage area.

Earthquakes and Recent Faulting

Faults are typically considered to be inactive if movement has not taken place during the last 10,000 years (Knight Peisold 1997). Under this definition, the only active faults in the vicinity of the Rock Creek Project are the Rainy Creek Fault (21 or more miles to the northeast of the project area) and the Thompson Valley Fault (50 miles east of the project area). Both show evidence of movement within the last 10,000 years. The Bull Lake Fault shows evidence of movement several hundred thousand years ago. ASARCO's seismic evaluations were based on potential movement of this fault, which is about 18 miles to the northeast of the project area. The Hope Fault, which passes the project area some 1,000 feet to the southwest, shows no evidence of movement over the last 1 million years.

The largest historic earthquake to occur in the Intermountain Seismic Belt, which includes the project area, was the 1959 Hebgen Lake, Montana, earthquake. This earthquake had a local magnitude of 7.1 (Richter Scale) and the earthquake was located over 300 miles to the southeast of the project area.

The Hope Fault marks the northern edge of the Lewis and Clark Line (LCL), a zone of major structural discontinuity (U.S. Army Corps of Engineers 1978). The Helena end of the LCL is more seismically active than the Sandpoint-Wallace end. The largest historic event in the Sandpoint-Wallace end was the Wallace earthquake (magnitude 5.0) of 1957, about 36 miles away.

Between 1918 and 1971, there were several other relatively large earthquakes ranging from about 15 to 45 miles away. They all rated IV to VI on the Modified Mercalli Intensity Scale. All of these, as well as the two mentioned above, were probably perceptible at the project site, but not damaging (ASARCO, Incorporated 1987-1994; Noranda Minerals Corp. 1989).

SOILS

Soils within the proposed permit area have developed since the last major climatic change which occurred at least 10,000 years ago. This is enough time for soils to develop recognizable differences that affect their use and productivity. The study area soils vary considerably in physical properties such as texture, coarse fragment content, depth, horizon sequence, organic matter content, and drainage. Some chemical characteristics vary widely such as nutrient levels and soil reaction. The 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. The most important soil characteristics affecting the proposed project are slope and soil rock content.

The soil mapping units identified in the proposed permit area (Noel 1986; ASARCO, Incorporated 1992) have been grouped into three categories, based on similarities in the processes that deposited the soil parent materials. These are colluvial/residual, alluvial and lacustrine soils (see **Figure 3-2**). Many of the soils in the study area, regardless of soil parent material, have a thin mantle of silt loam-textured volcanic ash which has blown in over the parent materials. The ash is important because it is essentially rock free and has a low bulk density, high moisture-holding capacity, and a high potential to hold nutrients and make them available to plants (Jones et al. 1979; Kuennen, Edson, and Tolle 1979; U.S. Forest Service 1972). The ash is also susceptible to erosion if disturbed.

Colluvial/residual soils are derived from materials that have moved downhill by gravity or from rock that has weathered in place. They comprise 45 percent of the proposed permit area. In general, soils in this group are on the steepest slopes in the study area and have a large percentage of rock in the upper five feet of the soil profile. Some residual soils are shallow to bedrock.

Alluvial soils have developed in materials that have been deposited by moving water. These soils make up about 40 percent of the study area and are found on floodplain terraces and slopes along the water courses in the study area. Generally they are deep soils and are on less steep slopes than the colluvial/ residual soils. Alluvial soils also have a large percentage of rocks in the profile.

Lacustrine soils comprise 15 percent of the study area and have developed from materials that were deposited in ancient Glacial Lake Missoula. Lacustrine soils occur on terraces and gentle protected slopes along lower Rock Creek near the confluence with the Clark Fork River. These soils are deep and on gentle slopes and are essentially rock free.

FIGURE 3-2 Permit Area 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. These inconsistencies actually represent an improvement in the data reporting procedures and are not an indication of errors in the database. 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. The new database reflects several reporting procedural modifications, such as removing duplicate samples from the data set; these modifications have been validated by the agencies.

As part of the new database submittal and at the request of the Agencies, ASARCO has 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 stastical analyses related to preparation of hydrology baseline for this supplemental EIS.

Tables from Chapter 3 of the draft EIS were recalculated as appropriate, and statitistics have been generated for all parameters and monitoring stations. 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. The DEQ used a value of zero for all values falling below the detection limit. Therefore, average values for DEQ data may be slightly less than average values using ASARCO data. The difference in the way detection limit values is handled 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 West Fork 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 3-3**.

West Fork Rock Creek

West Fork Rock Creek is a perennial stream with a drainage area of about 6 square miles. During certain periods of the year, portions of the West Fork are dry.

East Fork Rock Creek

The East Fork Rock Creek is a perennial stream above its confluence with West Fork. In 1985 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

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 lost into alluvium several hundred yards above Montana Highway 200. Rock Creek provides less than one percent of the total flow of the Clark Fork River below Noxon Dam. The area of the proposed Rock Creek mine is less than three percent of the total area of the Rock Creek watershed.

Miller Gulch

The proposed tailings impoundment would be located primarily within the Miller Gulch drainage. 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. Flow in Miller Gulch is currently diverted for power generation (DNRC Permit #PO29428), and for irrigation (DNRC Claim #W131972).

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 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 21,462 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. Volume of water coming through the dam and springs below the dam is approximately 1,440 cfs between turbine flow and the downstream USGS monitoring cable. Flow was estimated to be 144 cfs, which is 10 percent of the volume (see Appendix M for more detail on how this was calculated.

FIGURE 3-3 - Baseline Surface Water Monitoring Stations

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

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 (see **Figure 3-3**). Cliff Lake contributes to the headwaters of East Fork Rock Creek. Copper, Saint Paul, and Moran Basin lakes are located in the Bull River drainage. All four lakes appear to retain water year-round; however, outflows are intermittent or nonexistent during drier years.

Surface Water Quality

Tables 3-2 and 3-3 provide water quality data for Rock Creek at a monitoring station located at Montana Highway 200. **Tables 3-4 and 3-5** present data for the Clark Fork River at Noxon Bridge, and **Table 3-6** summarizes data for the Clark Fork River below Cabinet Gorge Dam. These data represent water quality baseline conditions. Rock Creek and the Clark Fork River below Noxon Dam are classified B-1 (ARM 17.30.607)[2].

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. 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 approaches 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. 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**).

Clark Fork River

Water quality results indicate a moderately hard water (61 to 100 mg/L), with concentrations of metals that are generally below water quality criteria. Nitrate plus nitrite as nitrogen range between less than 0.01 and 0.13 mg/L.

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). It was concluded that the Clark Fork River below Noxon and Cabinet Gorge Reservoirs is relatively unpolluted, and that river

[2]B-1 water quality standards may be obtained from the WQD.

TABLE 3-2
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, 1994.

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.

TABLE 3-3
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 3-4
Water Quality Data for Clark Fork River at Noxon Bridge
July 1984 Through August 1992

Parameter	Number of Samples	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	108	8.09	0.23	8.45	7.12
Total Suspended Solids	123	2.5	2.6	16.9	0.2
Total Hardness (as $CaCO_3$)	124	85.7	12.4	105	39
Total Alkalinity (as $CaCO_3$)	105	80.7	10.5	99	57
Ammonia (NH_3 as N)	125	0.0056	0.0114	0.07	<0.1[1]
Total Kjeldahl Nitrogen	124	0.1419	0.1063	0.6	<0.1
Nitrate + Nitrite	124	0.0273	0.0226	0.11	<0.01
Orthophosphate (PO_4-P)	125	0.003	0.0041	0.035	<0.001
Phosphorus (P) (TRC)	126	0.011	0.0087	0.062	<0.001
Arsenic (TRC)	63	0.0003	0.0005	0.002	<0.005[1]
Cadmium (TRC)	57	0.000642	0.002119	0.015	<0.001
Copper (TRC)	123	0.0003	0.0014	0.013	<0.01
Lead (TRC)	65	0.0002	.0006	0.003	<0.01[1]
Zinc (TRC)	124	0.0031	0.0058	0.041	<0.005

Source: Montana Department of Health and Environmental Sciences, Water Quality Bureau 1994.

Notes: All units are in milligrams per liter (mg/L) unless otherwise indicated.
Less than detection limit values assumed to be zero for statistical analyses.
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.

TABLE 3-5
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 3-6
Water Quality Data for Clark Fork River Below Cabinet Gorge Dam
July 1984 Through August 1992

Parameter	Number of Samples	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	109	8.1	0.22	8.5	7.44
Total Suspended Solids	122	2.4	2.7	18.7	0.3
Total Hardness (as $CaCO_3$)	125	84.3	11.9	104	60
Total Alkalinity (as $CaCO_3$)	106	79.7	10.4	97	54
Ammonia (NH_3 as N)	124	0.0031	0.0085	0.06	<0.01
Total Kjeldahl Nitrogen (as N)	123	0.148	0.1333	0.7	<0.1
Nitrate + Nitrite (as N)	123	0.025	0.0224	0.12	<0.01
Orthophosphate (PO_4-P)	124	0.0021	0.0039	0.036	<0.001
Phosphorus (TRC)	124	0.0099	0.0067	0.047	<0.001
Arsenic (TRC)	36	0.0003	0.0005	0.002	<0.005[1]
Cadmium (TRC)	65	0.000003	0.000025	0.0002	<0.001[1]
Copper (TRC)	124	0.0002	0.0011	0.011	<0.01
Lead (TRC)	66	0.0001	0.0005	0.003	<0.01[1]
Zinc (TRC)	125	0.002	0.0035	0.02	<0.005

Source: Montana Department of Health and Environmental Sciences, Water Quality Bureau 1994.

Notes: All units are in milligrams per liter (mg/L) unless otherwise indicated.
Less than detection limit values assumed to be zero for statistical analyses.
SU = Standard pH Units
TRC = Total Recoverable Metals Analysis

Shading = exceeds application water quality standards

[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.

water can either be phosphorus limited or co-limited by both nitrogen and phosphorus, with respect to algal growth. 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 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.

Clark Fork River Nutrient Studies

Summaries of information are contained in two independent investigations of nutrient levels in the Clark Fork River and Lake Pend Oreille. The first is the report by Priscu (ibid. 1989). Using Periphytic diatoms[3] 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 co-limited by both nitrogen and phosphorus, with respect to algal growth[4] (ibid. 1989).

Baseline nutrient conditions in Cabinet Gorge Reservoir were similar to the Clark Fork River. Priscu's report suggested this was to be expected because the calculated hydraulic retention time for Cabinet Gorge Reservoir ranges between one and 26 days, and averages only 5 days. This report also suggested that phytoplankton[5] data collected in Cabinet Gorge Reservoir between 1984 and 1985 indicated the absence of nuisance or noxious species.

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" (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 six years have been reduced several fold.

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[3] Periphytic diatoms - Diatoms, or algae 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.

[4] 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.

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

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.

Pend Oreille Lake

Pend Oreille Lake comprises two different aquatic regimes in one water body (EPA 1996). The pelagic region[6], generally in the central and southern portions of the lake is deep, clear, and cold, and is classified as oligotrophic[7]. Water quality in this region of the lake has not changed since the 1950's. The nearshore littoral zone[8], which accounts for about 11 percent of the lake volume, is classified a meso-oligotrophic[9] and is the primary location for water quality problems. The highest nearshore algae 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.

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.

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

[7] 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.

[8] 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.

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

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 septic tank and Sandpoint and Priest River wastewater treatment facility effluent. While this is a small proportion of the load compared to the total, common sense suggests 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 Cliff and Copper lakes, Copper Gulch and a number of unnamed springs (see draft EIS for more details). Water collected at these sites is characterized by neutral 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.

Ground Water Quantity

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.

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/Paste Facility Site

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 can be expected to flow toward the Clark Fork River.

Proposed and Alternate Mill Sites

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). 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.

Ore Body

Ground water in fractured bedrock probably accumulates from long-term recharge from precipitation and snowmelt, and is typically held in storage in bedrock void spaces. However, small quantities of ground water may also flow long distances through interconnecting fractures. Therefore, ground water in fractured bedrock may provide flow to deeper, regional ground water flow systems (assumed to be 500 feet below ground surface), or may discharge at the surface to springs and seeps.

Lakes in the vicinity of the ore body do not appear to be connected to the underlying ground water system.

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; 1995; 1997b).

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 3-7**. **Table 3-8** 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 3-9** and **3-10**, respectively.

TABLE 3-7
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 3-8
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 MetalsAanalysis
# of detections = Number of samples in data set above detection limit. The detection limit value was used in the statistical calculations.

TABLE 3-9
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 3-10
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.

Noxon Landfill

The former Noxon sanitary landfill is located within the proposed tailings impoundment area. No hazardous wastes or chemicals have been identified in the Noxon landfill area (ASARCO, Incorporated 1987-1994).

WATERS OF THE U.S. AND WETLANDS

Waters of the U.S. and wetlands were identified and delineated for the baseline inventory (ASARCO 1993). In their natural condition, waters of the U.S. and wetlands 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 waters of the U.S. and wetlands in order to minimize potential impacts and to provide compensation for any unavoidable impacts through restoration or creation activities.

ASARCO prepared a wetlands inventory for the proposed Rock Creek project area by ASARCO (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 3-11**).

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 Upper Perennial Riverine, the Forested Palustrine, and Emergent Palustrine Wetland systems. The non-wetlands waters of the U.S. are primarily unconsolidated bottom and shore classes of 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 Upper Perennial Riverine and Forested Palustrine wetland systems. Localized wet areas downstream of isolated springs and seeps also occur and are classified as Forested Palustrine wetlands. These wetlands have developed primarily in poorly and very poorly drained glaciolacustrine sediments.

The wetlands and non-wetlands waters of the U.S. were also inventoried for four potential subsidence areas around Copper and Cliff Lakes in the Cabinet Mountain Wilderness area. The lakes are classified within the Palustrine system because they are smaller than 20 acres and lack some distinguishable characteristics necessary to meet a Lacustrine System (Cowardin et al. 1979).

The non-wetlands waters of the U.S. associated with Copper and Cliff Lakes are primarily aquatic bed and unconsolidated bottom classes. The wetlands around these lakes are both forested wetlands and emergent palustrine wetland systems.

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

TABLE 3-11
Wetlands and Waters of the U.S. Acreage
Rock Creek Project Area

Unit Description	Acreage
Wetlands	10 acres
Non-wetlands 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.

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 Emergent Palustrine wetlands.

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).

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 Fork and West Fork 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 1995; Hydrometrics, Inc. 1997).

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 1995; Hydrometrics, Inc. 1997).

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 1995; Hydrometrics, Inc. 1997b).

The wetlands 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. Wetland functions and values were not assessed using a standard, semi-quantitative evaluation assessment technique.

The functions and values of the delineated wetlands 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. Wetlands functions considered to be of moderate importance were No. 4 — sediment and toxicant retention, No. 5 — nutrient removal and transformation, No. 6 — shoreline and streamback stabilization, and No. 7 — production export. The wetland 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 are associated with Rock Creek, East Fork Rock Creek and West Fork Rock Creek which support fish, as well as Copper and Cliff Lakes. Grizzly bear, which is listed as a threatened species, may also use the wetlands on a seasonal basis (ibid.).

AQUATICS/FISHERIES

Since the draft EIS was produced, additional field data have been collected from Rock Creek. The draft of 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). 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 1996). 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 analyses presented in this section since the draft EIS was completed do not substantively change the picture of the affected environment for aquatics/fisheries. The analyses do, however, strengthen the impacts conclusions presented in **Chapter 4** because they are based on a larger dataset.

Rock Creek

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 1987; J.E. Huston, Department of Fish, Wildlife and Parks, pers. comm. with Ginger Thomas, March 21, 1994).

Mainstem Rock Creek has an average gradient of 5.2 percent (WWP 1996). Substrate in the lower reaches is comprised of high amounts of gravel (WWP 1996). 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 3-12)**. The mean percentage of sediment less than 0.25 inch in diameter was not significantly different from 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 WWP (1996) 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 (Weaver and Fraley 1991, 1993). Therefore, survival to emergence in the portion of Rock Creek downstream of Engle Creek 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.

Surface fines in sediment (less than 0.25 inch diameter) were also measured in mainstream Rock Creek by WWP (1996) 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 analyzed 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 1996). In 1996, the percentages ranged from 0 to 22.6 over eight stations, with a mean of 10 percent (Watershed Consulting 1997).

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 1996). 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).

TABLE 3-12
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 East and West Fork Rock Creek; sampled by Washington Water Power (1996); samples collected downstream of confluence with Engle Creek (Smith 1994)

East Fork 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 1996).

West Fork 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 1987). 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 1996).

The West Fork 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 (R.W. Smith, Washington Water Power Company, pers. comm. with Ginger Thomas, March 3, 1994). 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 3-13**), 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 West Fork Rock Creek is predicted to be 37 percent for westslope cutthroat and 38 percent for bull trout.

TABLE 3-13
Percentage of West Fork Rock Creek Sediments[1] Less than 0.25 Inch Diameter

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 WWP (1996)
[3] = reach 2 extends from RM 0.4 to RM 0.6; sampled by WWP (1996)

Aquatic Plants

Baseline data for periphyton were collected at nine stations in the Rock Creek drainage (**Figure 3-4**) during April, August, and October 1985. Species composition in Rock Creek reflects its clean, soft water (Hydrometrics, Inc. 1986). Periphyton data collected in 1993 indicate that chlorophyll content and net productivity within mainstem and East Fork Rock Creek were relatively high compared to average values within the Lower Clark Fork River drainage (WWP 1996). For West Fork Rock Creek, the same measurements were relatively low compared to average values within the drainage (WWP 1996). 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.

Figure 3-4 Aquatic Insect, Periphyton and Sediment Sampling Sites

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 3-4**) for 4 years (1985-1988) during April, August, and October (ASARCO, Incorporated 1987-1994). 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.

Summaries of the quantitative macroinvertebrate baseline data appear in the draft EIS. Densities of macroinvertebrates were highly variable between sites, seasons, and years. 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 Rock Creek (WRC-1) shows higher average numbers of macroinvertebrates in April because that site was usually dry in August and October (ASARCO, Incorporated 1987-1994).

Overall, the sampling site on a tributary of West Fork Rock Creek (WRC-4) which flows through ASARCO'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 (**Tables 3-14, 3-15,** and **3-16**).

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 (B. Burkantis, Montana DEQ, pers. comm. with Tad Deshler, October 31, 1997). Rock Creek is currently on the 303(d) list due to metals and siltation (DEQ 1996).

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. **Table 3-17** presents a summary of these comparisons for the Rock Creek baseline data.

TABLE 3-14
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 Rock Creek
WRC = West Fork 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 3-15
Selected Metric Scores for August Sampling Events [1]

Station	Year	Number of organisms	Taxa Richness	EPT richness	% Dominant taxon	% EPT	Summary score
ERC-1	1985	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 Rock Creek
WRC = West Fork 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 3-16
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

Notes:

RC = mainstem Rock Creek
ERC = East Fork Rock Creek
WRC = West Fork 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 3-17
Impairment Assessment for Rock Creek Baseline Macroinvertebrate Data, 1985-1988

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
All April events	5	10	0
All August events	15	14	0
All October events	5	14	0

Note: RC = mainstem Rock Creek
ERC = East Fork Rock Creek
WRC = West Fork Rock Creek

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

None of the sampling events indicated severe impairment. More than half the sampling events for mainstem and East Fork Rock Creek indicated no impairment, but 22 of 28 sampling events for West Fork Rock Creek indicated moderate impairment. Seasonal effects were notable; August sampling events showed the highest proportion of no impairment scores (see **Table 3-17**).

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 macroinvertebrates 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 other category [which includes true flies (Diptera), beetles (Coleoptera), and other invertebrates] represented between 5 and 29 percent of the total sample (ASARCO, Incorporated 1987-1994). 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 (ASARCO, Incorporated 1987-1994). Similarly, perennial sites showed less evidence of impairment in the metric score comparisons (**Table 3-17**).

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 3-18.** A likely limiting factor for fish in this drainage is the three intermittent stream segments, RC-1, RC-4, and WF-1 (see **Figure 3-5**). These three segments have the lowest density of fish in the drainage (see **Table 3-18**). 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.

The East Fork Rock Creek has the highest fish density of any reach sampled in the Rock Creek drainage and the largest population of bull trout (Elliott and March 1997). Spawning by resident bull trout has not been confirmed, but data collected by Watershed Consulting (1997) (i.e., possible redds, bull trout in spawning condition, and young-of-year fish) indicate spawning has occurred.

TABLE 3-18
Fish Density Estimates and Fish Species Composition in Rock Creek, 1985-1996

Section & Date Sampled	Source	Density of fish (fish/100 ft^2)(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 3-18

(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 1996
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

-- 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 3-5 STREAM SEGMENTS AND SAMPLE SITES FOR FISH

The West Fork Rock Creek was sampled in the (upstream) perennial sections for the first time in 1993 (see **Table 3-18**). With the exception of station WF6, located just downstream of the waterfall (see **Figure 3-5**), 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 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 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 possible (WWP 1996).

Populations of westslope cutthroat trout and brook trout appear to be permanent (nonmigratory) residents of Rock Creek. Rock Creek may support both resident and migratory bull trout. In West Fork Rock Creek, 1-to-3-year-old bull trout have been found upstream of a temporary fish barrier consisting of sedimented large woody debris located approximately 1.2 km above the confluence with Rock Creek (WWP 1996). This barrier has been estimated to be in place for at least 2 to 3 years, prior to 1993, potentially indicating a resident, isolated population of bull trout in upper West Fork Rock Creek (Smith, pers. comm. with Ginger Thomas, March 3, 1993). During a more recent survey, this barrier was not observed (Watershed Consulting 1997). 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).

In addition, there is evidence of bull trout migration from Cabinet Gorge Reservoir into Rock Creek, presumably for spawning. Hightower and Vashro (1986) collected a 27-inch bull trout that appeared to be from Cabinet Gorge Reservoir at section RC-2. Other large bull trout have also been documented in Rock Creek (Joe Huston, Department of Fish, Wildlife and Parks, pers. comm. with Ginger Thomas, March 9, 1995). Although a small number of large bull trout which presumably migrated from Cabinet Gorge Reservoir have been observed in Rock Creek, spawning by these individuals in Rock Creek has not been documented. WWP (1996) indicated that the flows at the mouth of Rock Creek in recent years have been insufficient to allow upstream passage of fall-spawning bull trout from the reservoir. Hightower and Vashro (1986) commented on the presence of adequate spawning habitat in section RC-2 (a perennial segment). However, a recent study by WWP (1996) found high levels of fine sediment in potential spawning areas of RC-2. Although migratory and resident bull trout may use RC-2 for spawning, fry may experience low survival-to-emergence as a result of high sediment levels.

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 3-18**), 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. However, there appeared to be a shift in species composition toward relatively more brook trout and fewer cutthroat trout. This may be explained by the fact that a side channel (denoted MS3A in 1996 sampling) was sampled in 1993 that had not been sampled

previously. This side channel contained brook trout almost exclusively (Smith, pers. comm. with Ginger Thomas, March 3, 1994).

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 1996). 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

Metals concentrations were analyzed from westslope cutthroat trout collected from Rock Creek and the East Fork 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 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 the U.S. FDA (1994) action level (1.0 ppm) for edible fish.

Threatened, Endangered, and Sensitive Species

Both dominant fish species in this drainage (bull trout and 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 Department of Fish, Wildlife and Parks (DFWP). A proposal to list the Columbia River population segment of bull trout as threatened species was published in the Federal Register on June 13, 1997.

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 (Huston, pers. comm. with Ginger Thomas, March 21, 1994). 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 has been meeting monthly since September 1996 to coordinate the fisheries component of the relicensing effort (Swant, pers. comm. 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 1985a). 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 produce much zooplankton. 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 (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 (Sheldon, pers. comm. with Tad Deshler, April 7, 1997).

Fish

Sixteen fish species are found in Cabinet Gorge Reservoir. The relative abundance of these fish is reported in **Table 3-19**, which shows fish captured during 1960 and 1985 gill-netting. (Although no northern pike were collected during gill netting, they have been known to be in the reservoir since 1974.) Stations CG-1 and CG-2 had the lowest catch per night of the four stations (8.4 fish per net night). These stations are more river-like than the other two stations. Northern squawfish, peamouth, and mountain whitefish were the most abundant fish species at station CG-1. Game fish species collected at CG-1 included mountain and lake whitefish, and brown and bull trout.

TABLE 3-19
Average Monthly Catch Per Net Night for Fish Captured in Gill Nets in Four Locations on Cabinet Gorge Reservoir, July - November 1985

Species	CG-1	CG-2	CG-3	CG-4	Average 1985	Average 1960
Mountain whitefish	1.4	3.9	1.8	0.2	1.8	<0.1
Lake whitefish	0.7	0.2	0.1	--	0.3	0.3
Brown trout	0.6	0.9	1.1	--	0.4	<0.1
Rainbow trout	--	0.8	0.1	--	0.2	9.1
Westslope cutthroat trout	--	0.3	--	--	0.1	<0.1
Bull trout	0.1	0.3	--	--	0.1	0.8
Brook trout	--	--	0.1	--	<0.1	<0.1
Yellow perch	1.0	0.2	5.3	0.7	1.8	0.9
Northern squawfish	1.8	0.7	6.9	1.3	2.7	5.9
Peamouth	1.6	0.6	1.7	10.4	3.6	3.0
Largescale sucker	0.2	--	1.3	--	0.4	6.3
Redside shiner	1.0	0.3	0.3	3.7	1.3	<0.1
Pumpkinseed	--	0.2	1.0	--	0.3	<0.1
Longnose sucker	0.1	--	--	--	<0.1	1.4
Largemouth bass	--	--	--	--	--	0.1
TOTAL	8.5	8.4	19.7	16.3	13.2	27.6

Source: Barnard and Vashro 1986; Huston 1985.

Notes: Station CG-1 was a bottom set located upstream from the mouth of Rock Creek. CG-2 was a surface set located in the mouth of Rock Creek. Station CG-3 was a bottom set 0.62 miles downstream from the mouth of Rock Creek. Station CG-4 was a surface set 0.69 miles downstream from the mouth of Rock Creek.

At station CG-2 mountain whitefish was by far the most abundant fish, mostly collected during July. Whitefish may have been in this area then because of cooler water flowing from Rock Creek.

Station CG-3 had the highest catch per net night of any of the stations. Northern squawfish were the most abundant fish, followed by yellow perch, mountain whitefish, peamouth, and largescale suckers. While station CG-4 had almost as many fish per net night as station CG-3 (16.3), only five species were collected at this site.

Gill net data from Spring 1960 are presented in **Table 3-19** in order to illustrate changes in fish species composition over time. Rainbow trout have not been abundant in Cabinet Gorge since the 1960 survey. Bull trout numbers have also declined since the reservoir was built in 1953.

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 East Fork Rock Creek (discussed earlier).

Threatened, Endangered, and Sensitive 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. 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) to be bull trout (Gaffney 1955).

In the years since the dam was constructed, bull trout numbers have declined, although both bull and westslope cutthroat trout populations persist in low numbers (Huston 1993). Bull trout were collected in 1985 at stations CG-1 and CG-2 in Cabinet Gorge Reservoir near and just upstream of the mouth of Rock Creek. No bull trout were collected at the two downstream stations (Barnard and Vashro 1986).

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). Pratt and Huston (1993) characterized this population 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.

Westslope cutthroat trout were collected at station CG-2 in Cabinet Gorge Reservoir in 1985 and then only in July (Barnard and Vashro 1986). 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).

Lake Pend Oreille

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 (Maiolie 1991). 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 (Rieman and Bowler 1980). 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[10] except mercury in northern squawfish. Regular consumption of northern squawfish could cause mercury intoxication in humans. Consumption of all other fish should pose no health problems.

Threatened, Endangered, and Sensitive Species

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).

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.

[10]Federal and state 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. In addition, the Food and Agriculture Organization of the United Nations has published a compilation of international legal limits for hazardous substances in fish (Nauen 1983). Hoelscher (1993) used the median of these legal limits as guidelines for evaluation of these data.

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 1993). Sensitive species are discussed in greater detail in the Biological Evaluation for Plant Species on file with KNF. 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 draft EIS indicated that the Montana Natural Heritage Program (MTNHP) was currently tracking 379 plant taxa. The 1997 list produced by the MTNHP lists 346 vascular plant species, 111 moss taxa, and one lichen of special concern (Heidel, B. 1997. Five plant species of special concern were identified during ASARCO's baseline field studies in the study area: Crested shield fern, Pointed broom sedge, Yerba buena, Black snake-root, and Fringecup (more detail on these species can be found in Chapter 3 of the draft EIS).

Comments on the draft EIS indicated that other potential MTNHP plant species of special concern and KNF sensitive species have been documented close to and in the study area in later years. Two Wavy moonwort plants were found on ASARCO property in 1995 by the Forest Service. Common clarkia plants were found near the tailings impoundment site in 1995 during timber stand exams.

The Agencies also checked with baseline studies conducted by Washington Water Power in 1993 and 1994 (Cabinet Gorge and Noxon Rapids Hydroelectric Developments 1993) No new species of special concern were found in these studies.

Crested shield fern is now called Buckler fern on the MTNHP list. It is not listed in Sanders or Lincoln county. The plant collections originally identified as crested shield fern in wetlands studies in the area were misidentified and are not the KNF listed sensitive species.

ASARCO contracted additional baseline studies in 1996. No populations of Wavy moonwort were found (Elliot 1996).

Wavy moonwort is listed by MTNHP as globally vulnerable and imperiled in Montana. ASARCO's consultants concluded that habitats suitable for moonworts in the Rock Creek area occur along 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 Engel Creek and Rock Creek where the Wavy moonworts were observed in 1995.

Common clarkia was included in the list of KNF sensitive plants or MTNHP plant species of special concern that would be affected by the proposed project, because it was not found in baseline studies within

the study area. It is listed here because it may still be found in additional studies and field reviews in the future. Common clarkia is listed by MTNHP as apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. In Montana it is listed as imperiled. Common clarkia grows in dry, open forests on south-facing slopes in the mountains from 2,800 to 6,800 feet in Montana (KNF 1995).

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. 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 (Sanders County Extension agent, pers. comm. 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.

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 (U.S. Forest Service 1994). Riparian and wetland communities, though comprising a small percentage of the landscape, are a very rich ecological component of the area (see **Waters of the U.S. and Wetlands**). 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 3-20 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.

TABLE 3-20
Representative Plant Species by Dominant Vegetation Type and Lifeform Class[1]

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

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.

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 ASARCO.

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.

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 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. This type of 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 for future old growth and are called replacement old growth.

All stands that meet the Kootenai National Forest’s definition of old growth including some stands that are too small to meet the Forest Plan stand size criteria, have been considered as old growth for Forest Plan MA 13 (pers. comm. L. Fairman, July 29, 1997). 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 (L. Fairman, pers. comm. with Sandy Jacobson, 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 is 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, p9).

Compartment 711 has limited old growth habitat (see **Table 3-21** and **Figure 3-6**). 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 3-6**). 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.

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 were observed or expected to occur, including 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 3-22**). 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.

TABLE 3-21
Summary of Existing Old Growth (OG) and Replacement Old Growth (ROG) Acreage Designated as MA 13 in Timber Compartment 711

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 (ARC Acres)	1032	650
Percent of Rock Creek Compartment 711*	7.4	4.6

Source: U.S. Forest Service KNF 1995
Notes: Total area in Rock Cr. Compartment 711 is 14,029 acres.
[1] Old Growth Emphasis Areas 8, 9, and 10 are in MA2-OG Semi-primitive Non-motorized Recreation

FIGURE 3-6: OLD GROWTH AND REPLACEMENT OLD GROWTH (MA 13) STANDS IN COMPARTMENT 711

TABLE 3-22
Wildlife With Selected State or Federal Designations That May Occur in Project Vicinity

Elk (MIS) Fisher (S; SPSC) Grizzly Bear (LT; MIS; SPSC) Hoary Marmot (SPSC) Lynx (S; SPSC) Mountain Goat (MIS; SPSC) Northern Bog Lemming (S; SPSC) Northern Rocky Mountain Wolf (LE; MIS; SPSC) Pygmy Shrew (SPSC) Townsend's Big-eared Bat (S; SPSC) White-tailed Deer (MIS) Wolverine (S; SPSC)	Bald Eagle (LE; MIS; SPSC) Barred Owl (SPSC*) Black-backed Woodpecker (S) Boreal Owl (S) Cooper's Hawk (SPSC) Flammulated Owl (S) Golden Eagle (SPSC*) Great Grey Owl (SPSC) Harlequin Duck (S; SPSC) Long-eared Owl (SPSC) Northern Goshawk (SPSC) Northern Pygmy Owl (SPSC) Northern Saw-whet Owl (SPSC) Olive-sided Flycatcher (SPSC) Osprey (SPSC*) Peregrine Falcon (LE; MIS; SPSC) Pileated Woodpecker (MIS; SPSC) Western Bluebird (SPSC*)
Coeur d'Alene Salamander (S; SPSC)	

Designation Codes:

SPSC	=	State species of special concern
SPSC*	=	State species of special concern, but management concern is outside of geographic area of project
LE	=	Federally listed as endangered
LT	=	Federally listed as threatened
S	=	Designated Forest Service sensitive species
MIS	=	Forest Service management indicator species

Source: Flath 1984; Reel et al. 1989; U.S. Fish and Wildlife Service 1995, Kootenai National Forest Bird Checklist, 1995.

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 Groves 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.

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 to sustain a harlequin 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 (J. Reichel, pers. comm. with Lisa Fairman, June 6, 1995). Three of these pairs are found on Rock Creek.

A considerable amount of new information on harlequin ducks has been collected since the draft EIS. The information pertinent to the ASARCO Rock Creek project follows. Monitoring and inventory has continued on Rock Creek and the other drainages in the Lower Clark Fork subpopulation. 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. A Literature Review and Summary of Research Priorities for Harlequin Duck (Reichel 1996) has been written outlining several research priorities specific to the project. Finally, a panel of experts in harlequin duck biology and management was convened to discuss existing conditions, project effects, and possible prevention of adverse effects or mitigation for the project.

The existing condition for harlequin ducks as presented in the draft EIS is generally confirmed by the 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 (ibid.). 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.

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 Literature Review (Reichel 1996) 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 *In* 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 extirpation (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 extirpated by overtrapping and habitat alteration (ibid.). A recent re-introduction program to establish the fisher back into 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, 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**.**

Lynx. 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 hares, their main prey (Ruggiero et al. 1994). Open areas discourage use by lynx and disrupt movement (Koehler 1990; Koehler and Brittell 1990 *In* Ruggiero at al. 1994). They are easily trapped. Humans are considered to the be the single most important mortality factor for lynx (Ward and Krebs 1985 *In* Ruggiero et al. 1994).

Range of the lynx in the western contiguous 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). 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 Wildlife Service, pers. comm. with Lisa Fairman, June 5, 1995).

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 County from 1977 to 1993 and all three were taken in 1984.

Considerable new information has been compiled since the draft EIS for lynx and its habitat. The new information has been summarized in the Kootenai National Forest's Lynx Conservation Strategy (Johnson 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 generally confirmed the existing condition explained in the draft EIS, except that it provided 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 area is limited in both denning and foraging habitat because most of it is lower elevation than lynx prefer. Of the 23,017 acres in the Lynx Management Unit 7-2-1, only 4.9% (1,134 acres) is considered denning habitat and 5.2% (1,195 acres) is considered 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 7 acres of travel habitat at the evaluation 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.

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. As mentioned previously, however, 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 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.

***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). This requirement for a large home range may be more related to the maintenance of the male's multiple pair bonds to forage requirements (Copeland, pers. comm. with Lisa Fairman 1995).

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 (Harvey Nyberg, Department of Fish, Wildlife and Parks, pers. comm. with Lisa Fairman, June 10, 1994) and fresh wolverine tracks observed during the wildlife baseline study (Farmer and Heath 1987) 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 is 405,492 acres of wolverine habitat (11,930 acres denning, 393,562 acres general), and on the Cabinet Ranger District 66,321 acres (2,955 acres denning, 63,366 acres general).

While wolverines appear to be relative generalists in habitat selection, female wolverines used 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 (Copeland pers. comm. with Lisa Fairman, 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. 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). 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).

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. 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.

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 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 (Summerfield 1995). However, lack of responses to calls during the surveys is not conclusive evidence of absence.

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). 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 Rock Creek. Surveys conducted in this area in 1992 did not reveal the presence of bog lemmings (J. Reichel, pers. comm. to 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.

Forest Service Management Indicator Species

KNF has identified eight wildlife species that are used to monitor the effects of planned management activities on groups 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 (J. Brown, pers. comm. 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 3-7**). 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 3-7**).

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 3-7**). 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.

FIGURE 3-7: GOAT KEY WINTER AND SUMMER/TRANSITIONAL RANGES

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 (J. Brown, pers. comm. 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 (B. Haflich, pers. comm. October 8, 1997).

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 Government and Green mountains, over a 9-year period by DFWP, 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 3-8**) (Farmer and Heath 1987). 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 3-8**) (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) 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

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.

FIGURE 3-8: BIG GAME RANGES

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 3-8**) (Farmer and Heath 1987). 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 (B. Sterling, pers. comm. 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) 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 (Terry McEneaney, Yellowstone National Park, pers. comm. 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). 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). The leopard frog, common in many parts of North America a few decades ago, is now suffering wide-spread extinctions. 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 (Jim Reichel, Montana Natural Heritage Program, pers. comm., 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, pg 213).

THREATENED AND ENDANGERED SPECIES

Five 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, peregrine falcon and gray wolf and the threatened grizzly bear and water howellia (McMaster 1997).

Bald Eagle. The proposed project site lies within the Upper Columbia Bald Eagle Recovery Zone of Montana (U.S. Fish and Wildlife Service 1986; Paige 1991). Bald eagles are residents in the Clark Fork River corridor. Over the past 10 years, sightings have varied from six to 38 eagles during a yearly 1-day January eagle count along the lower Clark Fork River from Thompson Falls to the Idaho state line. Farmer and Heath (1987) reported a total of 16 sightings in their study area, and a maximum five-bird sighting in a single day. **Figure 3-9** shows historic bald eagle sightings. Winter use level depends on ice conditions on Noxon and Cabinet Gorge reservoirs. When the reservoirs freeze, the eagles leave.

Eagles winter along the entire length of the Clark Fork River as it flows across the Cabinet Ranger District. Wintering habitat extends downstream to Lake Pend Oreille. Wintering habitat generally occurs within 1 mile of food sources (open water, big game winter ranges) and has adequate perch and sheltering roost trees (Montana Bald Eagle Working Group 1991). Wintering eagles have been observed feeding on dead deer along Montana Highway 200 within 0.5 mile of the proposed tailing impoundment. There are no suitable perch or shelter trees within the project area.

A total of 5 occupied eagle nesting territories exist along the lower Clark Fork River (all or partially within the Cabinet Ranger District boundary). The nests represent a 50% occupance of the 10 potential breeding areas on the Lower Clark Fork. This is below the desired management objective of 68%, prescribed in the Montana Bald Eagle Management Plan (1994, pg 15). Two nests in 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 1996. The second nest was discovered in March of 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 or 1997.

Nesting habitat is described as the largest living trees in a multi-storied stand near a body of water. The body of water must support an adequate food base (U.S. Fish and Wildlife Service 1986, pg 13). The nest trees provide an unobstructed view of foraging site(s). They have open crowns and sturdy limbs to support massive eagle nests. There are no suitable nest tree sites in the proposed project area.

Eagles forage for fish in the two reservoirs (Noxon and Cabinet Gorge) and the major tributary streams (Vermillion and Bull rivers). Eagles scavenge along the railroad tracks, FDR No. 150, and Montana Highway 200.

Trees suitable as hunting perches generally have an unobstructed view of the hunting area and are relatively close to it. There are no hunting perch sites within the project area because it is greater than 1 mile from Noxon Reservoir, the primary foraging area. There is a known hunting perch within ½ mile of the proposed tailings impoundment. It lies between Montana Highway 200 and the Clark Fork River.

FIGURE 3-9: BALD EAGLE SIGHTINGS

Peregrine Falcon. The project area is part of the Rocky Mountain/Southwest population recovery zone (U.S. Fish and Wildlife Service 1984). The peregrine falcon is a possible migrant throughout 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 (Bob Summerfield, Kootenai National Forest, pers. comm., October 12, 1993). In 1987, a pair nested and produced young at this site.

An important component of peregrine falcon habitat is the availability of tall cliffs (greater than 200 feet) for nesting (U.S. Fish and Wildlife Service 1984, pg 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 (Bob Summerfield, pers. comm., 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.

Gray Wolf. The project area lies outside the Northern Rock Mountain Wolf Recovery Area (U.S. Fish and Wildlife Service 1987, pg 23). The area is about 16 air-miles east of a potential dispersal corridor that runs along the Montana-Idaho border. The gray wolf is a potential transient through the lower Clark Fork Valley. There are two unconfirmed sightings in 1991 within 1 mile of the proposed Rock Creek tailings impoundment, and a second unconfirmed report of three wolves in the same area in 1995. There is a 1979 unconfirmed sighting within 1 mile of the proposed mill site. There are three unconfirmed reports of a pack (three animals) using the Pillick Ridge/Blue Creek areas, 7 to 15 air miles west of the project area in 1994. The only confirmed wolf report comes from the Vermilion River (1996) which is 14 air miles southeast of the project area.

An adequate prey base of elk and deer exists in the area to contribute to the support of a wolf pack. NFS lands in the project area downstream from Engle Creek are managed for big game winter range.

Den sites are generally greater than 1 mile from open roads or trails and 1 to 2 miles from campsites. 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 (ibid. pg 73). There are no known den sites in the Rock Creek drainage.

Rendezvous sites, and resting and gathering areas, are usually complexes of meadows and adjacent timber, with surface water nearby (ibid. pg 73). They tend to be away from human activity. There are no known rendezvous sites in the Rock Creek drainage.

Another component of wolf habitat is sufficient space with minimal exposure to human (ibid., pg 7). Space is discussed in the section on grizzly bear.

Grizzly Bear. The proposed project lies in the 2,600-square-mile Cabinet-Yaak ecosystem recovery zone (U.S. Fish and Wildlife Service 1993b). The grizzlies in the Cabinet/Yaak are listed as threatened but

the U.S. Fish and Wildlife Service determined that a reclassification to endangered was warranted but precluded (Fed. Reg. Vol. 58, No. 28, 1993, pgs 8250-8251). The current population estimate for this ecosystem is between 30 and 40 grizzly bear (Kasworm et al.1997, pg 6). The present population is thought to be old-aged and on the decline (Kasworm and Manley 1988). There were four young female grizzlies transplanted into the ecosystem from Canada over a 5 year period (1990-1994). One of these transplants has since died from apparent natural causes. Kasworm's research indicates a very slow increase in the population, as the number of known grizzly bears has increased from 10 in 1990 to 16 in 1996. A portion of the increase is due to greater search efforts, but a portion is also due to reproduction.

Recovery plan criteria indicate a need for 18 of the 22 BMUs (Bear Management Units) to be occupied by females with young. Ten of the 22 BMUs had credible sightings of females with young during 1991-1996. 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). 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.

Research (Kasworm and Others 1988 pg 39-49, 1995 pg 26-36) 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 have died since documentation of their home ranges. Bear movements in this area are generally in a north/south pattern (Wayne Kasworm, U.S. Fish and Wildlife pers. comm. with Wayne Johnson, KNF, 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 (1995, pg 10) documents 629 credible grizzly bear reports for the CYE between 1960 and 1994. His data reveal two areas in the Cabinet Mountains that contain a dense cluster of sightings (ibid. figure 2, pg 11). The first area lies several miles north of the proposed project, outside the area of influence. The second area is in the southern Cabinet Mountains between Ramsey/Rock creeks and Swamp/Lake creeks area. The primary analysis area for grizzly covers BMUs 4 (Bull), 5 (Saint Paul), and 6 (Wanless) (only portions shown in **Figure 3-10**). The proposed project would occur in Bear Analysis Areas (BAAs) 7-4-7, 7-5-2, 7-5-3 and 7-6-1 (**see Figure 3-10**). **Table 3-23** summarizes reports of grizzlies in these BAAs since 1960. BAAs are subunits of BMUs. Habitat components important to grizzly bear have been mapped for the proposed project area summarized in the Biological Assessment (see **Appendix B**). 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. 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). The Rock Creek drainage provides about the same proportion of key habitat types as other areas of the Cabinet Mountains.

Grizzly denning habitat is generally above elevation 5,200 feet and on north and west aspects in the Cabinet Mountains (Kasworm and Thier 1993, pg 44). The Rock Creek drainage does contain potentially suitable denning habitat, but none in the proposed project area. There are no known den sites in the Rock Creek drainage.

TABLE 3-23
Grizzly Sighting Reports Between 1960 and 1997

BAA	Visual Sitings (1960-1997)	Radio Locations (1983-1993)	Mortality (1975-1996)
7-4-7	11	1	0
7-5-2	7	6	1
7-5-3	5	21	0
7-6-1	7	7	0

Source: Kootenai National Forest 1997.

A cumulative effects analysis process was developed for the Cabinet-Yaak ecosystem (U.S. Forest Service 1988). This process is referred to as the Cumulative Effects Model (CEM). The CEM looks at habitat conditions and all human activities that could displace bears or result in bear mortality. The details of this process are described in the *Cumulative Effects Analysis Process for the Cabinet-Yaak Grizzly Bear Ecosystems* (Ibid.) and are summarized in the Biological Assessment (**Appendix B**). Habitat effectiveness or percent of the area free from human disturbance is one of the elements of this model. Based on the CEM, existing habitat effectiveness of each BMU is: BMU 4 - 64.7 percent, BMU 5 - 74.5 percent, and BMU 6 - 66.1 percent. The threshold of undisturbed habitat needed in each bear unit has been established at 70 percent (Christensen and Madel 1982; U.S. Forest Service KNF 1987).

The Kootenai National Forest Plan establishes an open road density (ORD)[11] on areas managed for grizzly bear (Management Area 14) of 0.75 miles per square mile. This same objective applies to each BAA. **Table 3-24** displays the current situation for open road density.

TABLE 3-24
Existing Open Road Density (Miles per square mile) Summary

BAA	ORD
7-4-7	0.72
7-5-2	0.83
7-5-3	0.00 (Wilderness)
7-6-1	0.91

Source: Kootenai National Forest 1994.

[11] ORD is the miles of road open to public use per 640 acres, or one section of land expressed as miles per square mile.

Figure 3-10: BEAR MANAGEMENT UNITS AND ANALYSIS AREAS

The ORD value for BAA 7-5-2 cannot be reduced further without closing portions of the primary access roads (150 and 2741). Primary access road 150 would need to be closed to improve ORD in BAA 7-4-7.

Another method of habitat effectiveness evaluation focuses on the percent of the analysis area, in this case the BMU, that provides core habitat. 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, pg 5). The baseline core habitat condition, in the south half of the Cabinet Mountains (cumulative effects analysis area), is shown in **Table 3-25**, and on **Figure 3-11** (BMU 22 not included as GIS connection was not available).

An additional method of looking at grizzly bear habitat uses a technique called the "moving window." This method looks at the percent of the analysis area that falls in various road density classes (**Table 3-26**). The baseline condition, using the moving window analysis method for the BMUs, in the cumulative effects analysis area is displayed on **Table 3-26.**

TABLE 3-25
Existing Core Habitat Analysis Summary
(% BMU in Core by Habitat Block Site)

BMU	0-4 Square Miles *	4-8 Square Miles*	> 8 Square Miles*	Total Percent Core
4 #	5.1	5.8	49.3	60.2
5 #	4.1	0.0	56.3	60.4
6 #	10.1	0.0	41.9	52.0
7 **	1.0	15.1	49.1	65.2
8 ***	3.3	4.0	48.7	56.0
22 ****	1.6	0.0	46.1	47.7

* Core habitat block size
\# Based on 8/97 analysis by Kootenai NF S.O.
** Based on 5/97 analysis by Cabinet Ranger District, KNF
*** Based on 2/97 analysis by Cabinet Ranger District, KNF
**** Based on Plains District (Lolo NF) analysis 5/97
Core does not include changes due to Montanore Noranda Mine as planned start is 1998 and core analysis was not available or required when the Montanore original analysis was conducted.

Figure 3-11 Baseline Core Habitat Condition

TABLE 3-26

Moving Windows Route Densities
(% BMU by Route Density Category)

BMU	Open Routes[1]					Total routes *[1]			
	0 miles	0-1 mile	1-2 miles	> 2 miles		0 miles	0-1 mile	1-2 miles	> 2 miles
4 #	46.9	14.1	15.0	24.0		43.9	13.7	14.3	28.1
5 #	57.9	13.5	15.3	13.3		43.3	16.5	17.1	23.0
6 #	53.3	13.9	12.9	20.1		41.9	13.2	15.5	34.3
7 **	49.2	15.6	14.5	20.8		49.1	21.7	17.2	16.0
8 ***	40.4	17.1	21.8	20.7		48.7	19.5	21.9	22.2
22 ****	45.0	13.0	15.0	27.0		46.1	13.0	14.0	42.0

* Does not include barriered roads (per IGBC Grizzly Bear Access Committee notes 2/97)
\# Based on 8/97 analysis by Kootenai NF S.O.
** Based on 5/97 analysis by Cabinet Ranger District, KNF
*** Based on 2/97 analysis by Cabinet Ranger District, KNF
**** Based on Plains District (Lolo NF) analysis 5/97
[1] Route density categories are miles of road per square mile.

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 are presented in Appendix B.

Water Howellia. Surveys for this species were conducted concurrent with the sensitive plant surveys. No occurrences of this species were found (Scow et al. 1987; ASARCO 1990; 1993; Montana Natural Heritage Program 1994).

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; U.S. Fish and Wildlife Service 1994, pg 35860). No suitable habitat exists in the planning area.

SOCIOECONOMICS

Local Employment and the Economy

The Sanders County economy has shifted from primary reliance on resource extraction to a predominance of services and trades. Services (such as business, health, financial and other) provide the largest sources of local employment followed by government employment; 25 percent and 18 percent,

respectively (see **Figure 3-12**). Other sectors include manufacturing (17 percent), wholesale and retail trade (15 percent), forestry and mining (15 percent), and construction/transportation (10 percent).

Services, dividends, retirement income and transfer payments provide 55 percent of total Sanders County personal income (Bureau of Economic Analysis 1993). Government employment provides about 14 percent of all personal income. Other sectors provide lesser amounts: manufacturing (11 percent), construction/transportation (7 percent), forestry and mining (7 percent), and wholesale and retail trade (6 percent). (See **Figure 3-13**). Sanders County incomes averaged $28,800 per household in 1991 for a county total of $97,783,000. County wages and salaries totaled $35,292,000 in 1991, equivalent to $15,600 per worker, 19 percent below the average Montana worker (Bureau of Economic Analysis 1993).

The civilian labor force in Sanders County has grown from 2,870 workers in 1970 to 3,784 in 1994 (a 1.16 percent average annual increase). The Sanders County labor force has varied substantially in recent years, from a low of 2,900 workers in 1993 to a high of 3,800 in 1994.

Over the past decade, the annual average Sanders County unemployment rate has been about 14 percent, double the Montana average of 7 percent over the same period. Lincoln county has experienced similarly high unemployment levels.

The three local counties (Sanders, Bonner, and Lincoln) can be described on a spectrum of economic and social factors. Sanders County described above has moved from a resource-extraction economy to a mixed economic base. Lincoln County is among the most resource-extraction-dependent counties in the region, having 20 percent of its jobs in wood products and 5 percent in mining (prior to the Troy Mine shutdown in 1993). Bonner County has a growing services, retirement, and recreation economy, with services providing 30 percent of county employment.

Population and Demographics

The population of Sanders County has increased by 2,750 persons in the last 44 years (an annual growth rate of 0.8 percent), from 6,983 persons in 1950 to 9,733 in 1994. Recent population has increased from 8,700 to 9,700 persons in the last 4 years. Sanders County's recent growth rates are significantly above statewide population growth patterns over the decade (U.S. Bureau of Census 1991, 1993, and 1995).

Community Services and Facilities

Schools

There are three elementary schools and two high schools in western Sanders County. The Noxon/Heron School District includes the Noxon Elementary and the Noxon High School. The Trout Creek School District has one elementary school whose students can attend either the Noxon or Thompson Falls high schools. The Thompson Falls School District includes elementary and high schools. **Table 3-27** lists these school district enrollments, and student/teacher ratios. Present student to teacher ratios range from 10:1 at Noxon High School to 19:1 in Trout Creek Elementary School. The Montana average student to teacher ratio is 15.8:1.

FIGUREs 3-12 and 3-13 (one page)
Sanders County Employment Trends
Sanders County Personal Income Trends

TABLE 3-27
Current Enrollment and Student/Teacher Ratios

District and School	1993-1994 Enrollment	Student/Teacher Ratios
Noxon Elementary/Junior High	202	16:1
Noxon High School	122	9:1
Trout Creek Trout Cr. Elementary	106	18:1
Thompson Falls Thompson Falls Elementary/Junior High	434	17:1
Thompson Falls High School	234	18:1

Source: Office of Public Instruction 1993.

Law Enforcement

Montana Highway Patrol, Sanders County Sheriff's Department, and Thompson Falls Police Department provide law enforcement coverage 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. Although staffed 24 hours per day, the 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. There is one Montana Highway Patrol officer stationed in Sanders County who patrols 115 miles of Montana Highway 200 from the Idaho line to Ravalli.

Fire Protection

Fire protection in western Sanders County is provided by the Noxon, Heron, Trout Creek, and Thompson Falls rural fire districts, the Thompson Falls Fire Department, DSL, and KNF. Noxon Rural Fire District is nearest to the project site. It has about 14 active volunteers and six inactive volunteers, operating out of a new three-stall fire station and a two-stall satellite station located at the junction of highways 56 and 200. It has mutual aid agreements with the Heron, Trout Creek, and Thompson Falls rural fire districts.

KNF is responsible for wildland fire protection of NFS and private lands within the study area.

Ambulance Services

There are two local ambulance services 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 and is staffed by 16 volunteers. Two emergency vehicles and one boat are maintained by Noxon Ambulance. 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 Valley Clinic (24 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 250 connections. Water Service, Inc. provides water service to about 100 Trout Creek customers. Trout Creek's water system is generally adequate. Heron is served by two 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, however the Heron Acres system is currently at capacity, thus requiring new Heron Acres residents to drill individual wells. Thompson Falls water system receives water from Ashley Creek and two wells. The water system is currently in fair shape and supplies about 600 connections. In western Sanders County, most residents outside the service area of Noxon, Heron, Trout Creek or Thompson Falls must rely on individual wells, springs, or hauled water.

Sewage Treatment

Rural residents of western Sanders County use individual septic tank/drainfield systems for wastewater treatment and disposal. All new septic systems are evaluated by the county sanitarian to assure 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 main street businesses and residences south of the railroad tracks and is operating near capacity. Waste treatment for the remainder of Thompson Falls is by individual septic systems.

Solid Waste Disposal

There is a countywide 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. One collection station is located immediately north of Montana Highway 200 near the FDR No. 150 junction. 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 service 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 a branch office in Thompson Falls. Thompson Falls also has a local alcohol treatment program.

Libraries

The public library is located in Thompson Falls. Interest in library service has continued to grow in recent years.

Housing

1990 census data are the most recent, detailed information on housing characteristics. There are an estimated 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 2,210 units in western Sanders County, about 80 percent are occupied, either by renters (20 percent) or by owners (60 percent). The remaining 20 percent are occupied seasonally. There are few houses currently available for rent.

Sanders County has few restrictions on housing placement outside of Thompson Falls. All new construction must have a general waste water/sanitation permit from the county.

Fiscal Conditions

Local property taxes provide less than one-half of total county revenues. Sanders County's total taxable property value was about $30 million in 1994. Sanders County per capita taxable value of $3,421 is 54 percent above the statewide average, thus the county's schools receive reduced state school funding to achieve statewide school funding equalization.

Land Use and Ownership

The western part of Sanders County has 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, logging and scattered residential areas. Western Sanders County is a rural area, having no major population centers. Occasional small towns, such as Trout Creek, Noxon, Heron and Clark Fork are scattered along the Clark Fork River Valley, connected by Montana Highway 200. The largest town in the county, Thompson Falls (population 1,319), is located about 39 miles southeast of the proposed permit area.

The bulk of private lands in the project area are held by small landowners, although two timber companies have substantial holdings. Private lands are managed for a variety of uses including logging, haying, recreation, and private residences, homesteads and businesses. There are an estimated 37 residences/businesses within 1 mile of the proposed project on the north side of the Clark Fork River. Most of these properties are located within 0.5 mile of Montana Highway 200. Lands immediately adjacent to ASARCO fee lands and mining claims include NFS lands, private timber holdings, and rural residential properties (see **Figure 2-6**). As local areas grow, they increase the total nutrient loadings in the Clark Fork River. The extent of future developments are expected to become restricted as area water quality reaches the limits of 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 ASARCO 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 3-28** shows average daily traffic (ADT) counts.

U.S. Highway 2 is a double-lane, paved highway running east to west across the state. Montana Highway 56 is a double-lane, paved highway running north and south between U.S. Highway 2 and Montana Highway 200. 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 (**Table 3-29**).

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 in **Table 3-30** is D and all have a dirt surface.

The maintenance level for FDR No. 150 is level 2 (see **Table 3-30**). This maintenance level is assigned where management direction requires a road 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 nearest commercial airports are in Missoula and Kalispell, Montana as well as Spokane, Washington. 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. Currently, there is no public bus transportation between the cities and towns listed above.

Existing railroad track is being operated by MRL 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

Recreational activities which occur on NFS lands in the Rock Creek vicinity include, but are not limited to: hunting, fishing, hiking, camping, huckleberry picking, firewood gathering, and recreational driving/viewing scenery. Primitive recreational opportunities are available in the Cabinet Mountain Wilderness (CMW). Cabinet Gorge and Noxon reservoirs provide additional fishing opportunities as well as boating recreation. A vehicle survey in 1985 was used to estimate that about 1,600 recreational use visitor days occurred in the Rock Creek drainage.

TABLE 3-28
Average Daily Traffic Count on Local Highways[1]

Road Segment	ADT[2]		
	1987	1992	1993
U.S. 2 Libby to MT 56 (15 Miles)	2147	2587	2783
MT 200 Plains to MT 56 (64 Miles)	2048	2393	2487
MT 56 MT 200 to U.S. 2 (34 Miles)	708	824	972

Source: 1987 Data, Don Cromer, Montana Department of Highways, pers. comm. with Art Compton, July 15, 1988; 1992 Data, Dennis Hult and Dan Martin, Montana Department of Transportation, pers. comm., October 19, 1993.

Note: [1] Counter - US2 at Jct. w/MT Highway 56, MT Highway 200 at Jct. w/MT?
[2] Average daily traffic or number of vehicles

TABLE 3-29
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
Note: 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.

TABLE 3-30
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.

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. This glaciated range features high craggy peaks, vertical cliffs, knife edge ridges, amphitheater-like basins, and filled valley bottoms. There are many streams, and about 85 lakes within the wilderness. Vegetation is abundant and varied, ranging from dense forests to high alpine plants. Numerous wildlife species use the wilderness, including grizzly and black bears, big horn sheep, and mountain goats.

The majority of human activity takes place along the trail systems that lead to lake basins, and within the lake basins themselves. Areas outside of the trail corridors and lake basins receive very light use, while some of the lake basins are somewhat degraded because of high visitor use.

CULTURAL RESOURCES

Cultural Resources 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). 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 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 (Schwab and Aaberg 1994).

A total of eight cultural resource sites were documented during three of the six surveys (Caywood 1986; Fredlund and Fredlund 1990; and Schwab and Aaberg 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. 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.

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 (Tiet 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 (Henry SiJohn pers. comm. 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 (Tiet 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 of 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, p12) 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 via telephone, 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 1979). 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) (see **Table 3-31**). 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. Environmental Protection Agency 1979). The effects of human sounds (highway traffic and logging) are low and normally less noticeable.

TABLE 3-31

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.
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 (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 draft 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 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, and 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 distances 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 3-14**). These objectives set measurable standards for the appearance of management activities. VMS VQOs developed for the project area include:

[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.

- ***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;

- ***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.

The Forest Plan also designates VQOs that may be less restrictive than those determined through VMS for most Forest Service management areas (see **Figure 3-15**). 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 3-14 Visual Quality Objectives - VMS

Figure 3-15 Visual Quality Objectives - Forest Plan

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter contains a condensed version of the Agencies' analysis of probable impacts to the human environment that would result from construction and operation of the proposed ASARCO Rock Creek Mine and its associated facilities (the Project). Impact analysis for Alternative V is described for all resources. Impacts for alternatives III and IV are described for those resources where impacts have changed based on new information or analysis methods. These resources include Forest Plan Direction, Biodiversity, and Threatened and Endangered Species. The reader must refer to the draft EIS for impact analysis of alternatives III and IV for other resources. It also contains the analysis of probable cumulative impact that would result from adding the proposed project to other existing and reasonably foreseeable activities in the project area and the Cabinet Mountains Wilderness, in the vicinity of Noxon, Montana.

Assumptions for the Action Alternatives

Certain assumptions were made in the following discussions. The following assumptions are for the purpose of this analysis only. These assumptions are not intended to be the final projection of future activities that may or may not materialize in the area over the next 30 years.

Assumptions used by the Agencies to perform the impact analysis for alternatives II through V include:

- Mining and reclamation technology would not change substantially throughout mine life.
- Labor, equipment, and/or market shortages/surpluses would not materially change projected levels of development.
- Impacts to copper/silver supply or demand are beyond the scope of this draft EIS.
- Mine production would last about 26 years. Exploration would last about 1 year and premining construction/development about 3 years. Although reclamation would be ongoing, postmining reclamation would last for 2 years. Life of the project is estimated to last about 32 years. However, some monitoring or mitigation might continue several years after mine closure.
- The project would be initiated sometime within the next 8 years.
- The ***short-term*** impacts of the project are those that would occur during the life of the project. ***Long-term*** impacts from the project are those that would persist beyond final reclamation bond release. *These impacts are discussed at the end of this chapter only if they would occur to a given resource.*
- An irreversible or irretrievable commitment of resources would occur when resources were either consumed, committed, or lost as a result of the project. The commitment of a resource would be ***"irreversible"*** if the project started a "process" (chemical, biological, and/or physical) that could not be stopped. As a result, the resource, or its productivity, and/or its utility would be consumed, committed, or lost forever. Commitment of a resource would be

considered ***"irretrievable"*** when the project would directly eliminate the resource, its productivity, and/or its utility for the life of the project. *These impacts are discussed at the end of this chapter only if they would occur to a given resource.*

- Qualitative terms are used to describe anticipated magnitude of impacts and, where appropriate, anticipated importance of impact to the human environment. ***"Significant"***, ***"potential to become significant"***, and ***"insignificant"*** describe importance (see Appendix A in the draft IS). *Impacts are considered to be insignificant unless identified otherwise.*

- ***Cumulative*** impacts are defined as collective impacts for the project when considered in conjunction with other past, present, and reasonably foreseeable activities. (These activities are described in **Chapter 2**.) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. *Cumulative impacts are discussed at the end of each resource impact section.*

Methodology

Methods used to gather data used for impact analysis for all resource areas are on file at Kootenai National Forest (KNF) and the Montana Department of Environmental Quality (DEQ) and may be reviewed by any person or party.

PART 1: ANALYSIS OF IMPACTS BY RESOURCE

Impacts are addressed by alternative within each resource. Alternative I, the no-action alternative, has substantially different impacts than any of the action alternatives. *For all of the action alternatives, only those impacts that would differ from previous action alternative(s) are listed. The reader may assume then that all impacts listed under Alternative II would occur under the subsequent alternatives (III, IV, and V) unless otherwise stated. All impacts under alternatives III and IV would occur under Alternative V unless otherwise stated.*

FOREST PLAN DIRECTION

Summary

The NFMA allows for changes in the Forest Plan. The KNF proposes changes to land management allocations from MA 11 (timber/winter range). MA 13 (old growth) and MA 14 (grizzly bear management) to MA 23, electric transmission corridor and MA 31 mineral development that would be needed if the project were approved. This would be accomplished in one amendment. This change would identify the management allocation for these areas with their associated goals, objectives, standards and guidelines. ***Appendix K*** *contains the actual MA amendment with the new MA 23 and 31 management area.*

Alternative I

Under Alternative I, there would be no changes to the Forest Plan. Compartment 711 would retain the current amount of acreage managed for old growth (MA 13) (see **Table 4-1**).

TABLE 4-1
Changes to Old Growth (MA 13) by Alternative

	Alternative Number				
	I[1]	II	III	IV	V
Old Growth Acres	1032	990	1010	1020	1031*
Percent in Compartment 711	7.4	7.1	7.2	7.3	7.3
Replacement Old Growth Acres	543	538	541	543	543
Percent in Compartment 711	3.9	3.8	3.9	3.9	3.9
Total MA 13 Acres	1575	1528	1551	1563	1574
PERCENT MA 13 (TOTAL)	11.2	10.9	11.1	11.2	11.2

Source: Kootenai National Forest 1997.
1 This column contains existing acreages and percentages of old growth.
Notes: There are 14,029 acres in Compartment 711 below elevation 5,500 feet.
Percentages do not add directly due to rounding.
* Less than one acre (0.4 acre) is physically removed along the utility corridor below the mill.

Alternative II

Timber sale offerings by the KNF in the Rock Creek drainage may be somewhat reduced during mine life to ensure that grizzly bear habitat is maintained at or above Forest Plan levels in this Bear Management Unit (BMU).

Mining activities will be encouraged under the appropriate laws and regulations and according to the direction established by the Forest Plan. While mineral exploration is an authorized use within these management areas (MAs), large scale mining development would reduce the area available for providing either grizzly bear or old growth dependent species habitat. Under this alternative, KNF would amend the Forest Plan by changing management area allocations on about 201 acres of National Forest System (NFS) lands managed for big game winter range, old growth, and grizzly bear habitat. These lands are managed under the Kootenai Forest Plan (U.S. Forest Service KNF 1987) as MAs 11, 13, and 14 (see **Tables 4-1** and **4-2**) and would be changed to MA 23 Electric Transmission Corridor; MA 31, Mineral Development; and some to MA 11 Big Game Winter Range. See **Appendices K** and **L** for MA 23 and 31 descriptions.

TABLE 4-2
Acres of NFS Lands to be Reallocated

Present Management Area	Areas reallocated to MA31 - Mining				Areas reallocated to MA 23 - Utilities				Areas reallocated to MA 11 - Big Game				Total Acreage Reallocated			
	Alt. II	Alt. III	Alt. IV	Alt. V	Alt.II	Alt. III	Alt. IV	Alt. V	Alt.II	Alt. III	Alt. IV	Alt. V	Alt.II	Alt. III	Alt. IV	Alt. V
MAs suitable for timber harvest																
MA 11 Big Game Winter Range	67	67	67	74	10	20	20	24	0	0	0	0	77	87	87	98
MA 14 Grizzly Habitat	52	60	43	34	25	26	14	14	0	0	0	0	77	86	57	48
MAs unsuitable for timber harvest																
MA 13 Old Growth [1]	24	8	0	0	11	5	1	1	12	11	11	0	47	24	12	1
Total Acres to be Reallocated	143	135	110	108	46	51	38	42	12	11	10.4	0	201	197	156	147

Source: U.S. Forest Service KNF 1997b.

* The acreages shown are less than those shown in the draft EIS. The change is due to more precise mapping using GIS and a new interpretation of the changes allowed in the MA before a revision is necessary.

1 Old growth acreage is acreage physically impacted along with an area between the mill and mine portals. For effective old growth habitat disturbed, see Biodiversity.

MA = Management Area

Note: Roads through each MA are included in MA acreage calculations.

Alternatives III and IV

See **Tables 4-1** and **4-2** for acreage changes by MA and acres of old growth affected.

Alternative V

Under Alternative V soil borrow sites along FDR No. 150B would not be needed, thus resulting in fewer KNF revisions to MA 13 and 14. Because of the paste plant, a few more acres of MA 11 would be impacted (see **Tables 4-1** and **4-2**). Proposed management area amendments to the forest plan are shown on **Figure 4-1**.

CLIMATE

Mining of the project under all alternatives would not have a detectable effect on the climate of the area. The amount of air pollutant emissions would be too small to affect precipitation or radiation balance.

AIR QUALITY

Summary

Based on anticipated air pollutant emission levels and corresponding analyses under all action alternatives, the overall impact to air quality in the area, including the wilderness area, would be minor. There would be a relatively small, localized increase in particulate and gaseous pollutants at the mill site and tailings impoundment areas. Air pollutant levels should remain well below state and federal ambient air quality standards. ASARCO would implement an air monitoring program. Following completion of operations, air quality conditions would return to near-current levels assuming adequate revegetation success.

Alternative I

Ambient air quality in the area would remain similar to its current condition and to possible future air quality conditions unrelated to mine development. The primary future air quality impact would probably result from population growth with increased vehicle traffic and home heating. No new significant industrial air pollution sources are anticipated in the area at this time.

Alternative II

Air pollutant emissions associated with the operation would originate primarily from three distinct sources: 1) the underground mine with the exhaust ventilation adits being the points of emission discharge (initially the service adit and later primarily the evaluation adit), 2) the mill site, and 3) the tailings impoundment. The estimated controlled air pollutant emissions from the project as reported in the original air quality permit application (TRC Environmental Consultants, Inc. 1987) and the addendum (TRC Environmental Consultants, Inc. 1995) are as follows:

Total particulate	=	97.0 tons per year
Nitrogen oxides (NOx)	=	64.0 tons per year

Sulfur dioxide (SO_2) = 9.9 tons per year

FIGURE 4-1 Forest Plan Amendment Management Areas 23 and 31

Carbon monoxide (CO)	=	76.9 tons per year
Hydrocarbons (HC)	=	9.6 tons per year

Computer simulation modeling of the estimated emissions was done to predict particulate and NOx concentrations resulting from the project. The maximum predicted concentration values including baseline concentrations are well below the applicable state and federal ambient air quality standards. Concentrations of a number of trace metals were also predicted and found to be less than applicable guideline values. The BEEST-X model was used with baseline meteorological data collected on-site (Montana Highway 200 site) from 1985 to 1986.

Visibility impacts were also estimated using screening model techniques. The results indicated that there would be no perceptible contrast change or general haze at the wilderness area. The reduction in visual range related to plume material was estimated at 0.11 percent. This compares with the commonly accepted limit of perceptible visual range reduction of 5 percent.

An acid deposition analysis was performed by the Forest Service to evaluate the project's effects on the pH and neutralizing capacity at sensitive lakes in the wilderness. This analysis also included cumulative effects for the Noranda Montanore project. The model results do not project any changes in pH or alkalinity in upper and lower Libby lakes from the Rock Creek project alone or from cumulative emissions.

A specific air quality concern with the project is the potential for wind erosion from the tailings impoundment area. If tailings surfaces are allowed to dry, there would be a significant potential for wind erosion to occur, given the fine texture of the material. The proposal includes a management and water sprinkling plan for dust control. On-going inspections would be used to evaluate the adequacy of the plan and the need for any further action.

Air quality impacts related to construction activities are also a specific concern. This applies mainly to tailings impoundment and plant site construction. Work areas and temporary roads would be watered or chemically stabilized to control these emissions. Evaluation adit development would cause short-term particulate and gaseous emissions. Additional emissions, primarily nitrogen oxides, would result from two onsite 500 kW diesel-fired generators. The evaluation adit would ultimately be used for at least a portion of the mine ventilation exhaust.

Secondary or indirect emissions related to the project would result from population growth. These would be primarily from increased vehicle traffic and home heating/wood burning, but would not be expected to exceed ambient air quality standards.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Several components of Alternative V would reduce air pollutant emissions and resulting impacts. The following describes these:

1. Paste Technology Tailings Management - A tailings paste with a much lower water content than a slurry would be generated. This allows for alternative construction methods. Paste tailings would be deposited in panels with some concurrent reclamation and reduced exposed tailings area reducing the potential for wind erosion.

2. Electric Underground Mining Equipment - Most underground mobile equipment would be electric powered. The diesel fueled equipment would be cleaner burning. Air pollutants reductions of about 60 percent are estimated from these changes.

3. Propane Generators - Two cleaner burning propane generators (545 kW and 735 kW) would be used during the evaluation adit development phase of the operation.

4. Concentrate Slurry - Processed concentrate would be transported from the plant site to the Miller Gulch rail siding by slurry pipeline rather than by haul trucks, eliminating the emissions associated with hauling.

5. Semi-Autogenous Grinding (SAG) Mill - The surface dry milling operation (secondary crushing) would be replaced by a fully wet milling operation (SAG mill), reducing particulate emissions.

Appendix J contains a copy of the Revised Preliminary Determination on the air quality permit application for this project. ASARCO submitted revisions to the air quality permit application on March 28, 1997 and May 29, 1997. These revisions correspond to Alternative V. More detailed information on the following items can be found in the Revised Preliminary Determination and the revised air quality permit application (TRC Environmental Consultants, Inc. 1997).

Total estimated emissions (tons per year) by pollutant type from the production phase and the evaluation adit development phase (propane generators) are shown in **Table 4-3.** Production phase and evaluation adit development emissions would not be generated concurrently. **Table 4-4** summarizes the estimated emissions and emission control practices for the production phase of the project.

Computer dispersion modeling (BEEST-X model) was used to predict PM-10, NOx, and SO_2 concentrations resulting from this operating scenario. The results are included in **Table 4-5** and indicate compliance with state and federal ambient air quality standards. **Table 4-6** compares the modeling results to prevention of significant deterioration (PSD) increments. An updated visibility analysis was also done. The estimated reduction in visual range caused by plumes was estimated at 0.015 percent compared to the commonly accepted limit of perceptible visual range reduction of 5 percent. The VISCREEN model was used to estimate the potential impact of a plume resulting from individual emission sources. No screening criteria were exceeded in this level 2 analysis.

A concern for acid deposition impacts to some wilderness lakes had been raised due to their low neutralizing capacity. The proposed project site facilities are located about 2.7 to 4.5 miles from upper and lower Libby lakes. The Libby lakes are key AQRV's (Air Quality Related Values) in the Class I wilderness area (Kettner 1993). Both lakes are positioned on the crest of the Cabinet Mountains in small Revett Quartzite watersheds (Harrison et al. 1990). The lake watersheds have very limited mineral weathering, poorly developed soils, and sparse vegetation. The low amount of alkalinity (which neutralizes acid

TABLE 4-3
Total Estimated Emissions (Tons per year)

	Production Phase	Evaluation Adit
PM-10	5.6	--
NOx	16.3	34.8
SO_2	1.8	--
CO	98.1	48.1
HC	3.4	30.9

Source: TRC Environmental Consultants, Inc. 1997
-- Not Applicable

TABLE 4-4
Estimated Pollutant Emission Inventory and Emission Controls

Source/Activity	Pollutant	Uncontrolled Emissions (tons/year)	Type of Control Equipment/Practice	Estimated Control Efficiency (percent)	Controlled Emission (tons/year)
Blasting	PM-10	0.3	Stemming, Drill Hole Size Optimization, Rubble	--	0.3
	NOx	12.8	Watering	--	9.1
	SO_2	1.5	Control Overshooting	--	1.5
	CO	92.5	Control Overshooting, Low Sulfur Fuel Oil Control Overshooting	--	92.5
Diesel Equipment	PM-10	--	Particulate Matter Trap Renewal: Low Ash Fuel	--	0.1
	NOx	--	DITA Engines[1]	--	5.0
	SO_2	--	Low Sulfur Diesel Oil	--	0.3
	CO	--	Frequent Tune-ups to Manufacturer's Specs	--	4.8
	HC	--	Frequent Tune-ups to Manufacturer's Specs Evap. Control System Maintenance	--	3.2
Space Heating Propane Comb.	PM-10	0.2	Use Propane, Routine Maintenance Schedule	--	0.1
	NOx	5.0	Maintain Near-Stoichiometric Atmosphere	--	2.2
	CO	1.2	Maintain Near-Stoichiometric Atmosphere	--	0.8
	HC	0.2	Routine Fuel Delivery and Burner System Inspection/Renewal	--	0.2
Primary Crushing	PM-10	15.0	High Efficiency Wet Scrubber	98	0.3
Surface Milling	PM-10	--	Wet Process	--	Neg.
Ore transfer	PM-10	106.2	Baghouse	99	1.1
Road Dust	PM-10	---	Paving	--	Neg.
Tailing Impoundment	PM-10	--	Paste Tailings, Concurrent Reclamation	--	3.7

Note: The service adit and later the evaluation adit are the emission points for blasting, diesel equipment, space heating, and primary crushing.
[1]DITA - Direct Injection Turbo-Charged Aftercooling
-- = Not Applicable

TABLE 4-5

Comparison of Maximum Predicted Concentrations With National And Montana Ambient Air (Production Scenario)

Time Interval	Maximum Contribution $\mu g/m^3$	Background Concentration $\mu g/m^3$	Contribution Plus Background $\mu g/m^3$	MAAQS/NAAQS
PM_{10} 24-hour[(a)]	5.16	41.20	46.4	150
PM_{10} Annual [(b)]	2.00	10.54	12.54	50
SO_2 1-hour	257.1	35.0	292.1	1,316
SO_2 3-hour	67.09	26.0	93.1	1,300
SO_2 24-hour	12.16	11	23.2	263
SO_2 Annual [(b)]	0.52	3	3.52	53
NO_2 1-hour	--	--	0.209 ppm	0.30 ppm
NO_2 Annual [(b)]	--	--	9.55	100

(a) 24-hour concentration expressed as high, second-high values.
(b) Annual modeled contributions expressed as arithmetic mean.
$\mu g/m^3$ microgram per cubic meter
ppm parts per million

TABLE 4-6

Comparison of Maximum Modeled Concentrations With Applicable PSD Increments

Pollutant	Time Interval	Class I Predicted Concentration $\mu g/m^3$	Class II Predicted Concentration $\mu g/m^3$	Class I Increment $\mu g/m^3$	Class II Increment $\mu g/m^3$
PM_{10}	24-hour	1.3	5.16	8	30
PM_{10}	annual	0.075	2.00	4	17
SO_2	3-hour	16.5	67.09	25	512
SO_2	24-hour	3.36	12.16	5	91
SO_2	annual	0.19	0.52	2	20
NO_2	annual	1.74	4.74	2.5	25

$\mu g/m^3$ = micrograms per cubic meter

deposition from rain, snow, and dry deposition) results in the high sensitivity of the Libby lakes to acid deposition induced chemical change.

Potential acid deposition effects on upper and lower Libby Lakes from the ASARCO Rock Creek Project and cumulative effects for the Noranda Montanore project were evaluated using the MAGIC/WAND (Model of Acidification of Groundwater in Catchments/With Aggregated Nitrogen Dynamics). The MAGIC/WAND model (Cosby et al. 1985a and 1985b; Jenkins and Renshaw 1995) is a lumped parameter model of intermediate complexity, which predicts the long term effects of acidic deposition on surface water chemistry constituents (Ca, Mg, K, Na, NH4+, H+, ANC, Cl, Al, H2CO3) in deposition, routing, and flux analysis of atmospheric deposition and watershed interactions (bedrock, soils, and lake dynamics).

The WAND component of the model factors in the primary nitrogen fluxes by accounting for nitrogen mineralization, nitrification rate, and plant uptake. The meteorological and deposition input requirements for MAGIC/WAND include wet deposition concentration, precipitation, and annual air temperature. The spatial and temporal scaling capability of the MAGIC/WAND model allows evaluation of changes in atmospheric deposition to a lake watershed from potential upwind emission sources but requires separate dispersion modeling to estimate and input deposition changes. Emission rates were based on the Alternative II scenario; these are higher than under Alternative V emission rates and represent a worst-case analysis.

The MAGIC/WAND modeling procedure for Libby lakes consisted of (Bernert et al. 1997; Story 1997):

1) Collection of watershed information for each lake (maps of watershed features and lake depths, soil and water chemistry, soil physical properties, and vegetation composition and chemistry, and climatic and hydrologic information).

2) MAGIC/WAND hindcasts (1845-1995) for both upper and lower Libby lakes to calibrate the lake chemistry to precipitation chemistry and watershed/soil conditions.

3) Potential incremental acid deposition to each lake watershed during the construction and production phase of the ASARCO Rock Creek Project and the NORANDA Montanore Project were estimated using emission inventories and the ISC-ST3 dispersion model.

4) MAGIC/WAND forecasts of ASARCO only and Montanore cumulative emissions were run from 1996 to 2045 to model potential chemical changes upper and lower Libby lakes. The forecast assumed both mines would be constructed and operated in a simultaneous period from 2000 to 2030.

Table 4-7 includes a summary of modeling results for the 1995 (pre-mine) base year and 2030 (maximum cumulative 30 year emissions of the lake watersheds/soils/lake chemistry).

The upper Libby lake modeling results indicate less base cation generation and more release of acid anions than lower Libby lake. This is due to the smaller catchment and less soil and vegetation in the upper Libby lake watershed. In upper Libby lake, acid anions are projected to increase by a maximum of 2.9% in 2030 for the ASARCO + Montanore cumulative emissions while base cations would decrease by about 1%.

In lower Libby lake, acid anions are projected to increase by an estimated 2.8% for the ASARCO + Montanore cumulative emissions while base cations would increase by about 1.1%. The increase in base cations, if it actually occurred, would be attributable to a modeled increase in weathering of bedrock and soils.

TABLE 4-7
MAGIC/WAND Modeling Results for Libby Lakes

Activity	Year	pH	Alkalinity μeq/L	Sum Base Cations μeq/L	Sum Acid Anions μeq/L
Upper Libby lake					
pre-mine base year	1995	5.69	8.90	17.39	10.4
ASARCO emissions only	2030	5.69	8.90	17.27	10.51
ASARCO + Montanore emissions	2030	5.69	8.90	17.27	10.68
Lower Libby lake					
pre-mine base year	1995	5.93	18.07	24.85	7.84
ASARCO emissions only	2030	5.93	18.07	24.7	7.94
ASARCO + Montanore emissions	2030	5.93	18.07	25.03	8.06

(Story 1997)
μeq/L = microequivalents per liter

The estimated changes in acid anions and base cations are not sufficient for the MAGIC/WAND model to project any changes in pH or alkalinity in upper and lower Libby lakes for either the ASARCO emissions only or ASARCO and Montanore cumulative emissions. The modeling results are due to the relatively low levels of project mine emissions and associated low dispersion model projections of percent increases in nitrogen and sulfur deposition to the Libby lakes.

Cumulative Impacts

Cumulative air quality impacts under all action alternatives would be reviewed for specific proposed projects and developments that require air quality permits in the area. Logging and small scale mineral exploration activities typically do not require air quality permits; however, general air quality conditions would be analyzed through ASARCO's ambient air quality monitoring program. Slash-burning activities are regulated by open burning rules. Particulate and gaseous emissions (primarily NOx and CO) would increase in proportion to increased vehicle activity associated with future logging and/or mineral development; however, it is not likely that ambient air quality standards would be approached. The air quality permit process and specifically the PSD regulations would act to regulate and possibly limit future development based on cumulative impact. No measurable cumulative or additive impact would be expected with respect to Noranda's Montanore Project based on distance and topographic considerations. Population growth unrelated

to the project may increase vehicle traffic and home-heating/wood-burning emissions. Cumulative emissions likely would not exceed air quality standards.

GEOLOGY

Construction of the project facilities for all action alternatives would alter the existing topography and surface water drainage patterns in the tailings storage area (Miller Gulch). The most noticeable alterations of existing topography would be the construction of a tailings impoundment or paste tailings facility and mill site.

Mining would result in a total production of about 166 million ounces of silver and 1.37 billion pounds of copper. This would increase domestic production of these metals and would have a positive effect on the U.S. gross national product and balance of trade.

Under all alternatives the potential would exist for the project to influence water levels in overlying lakes and influence local springs or seeps. Data that pertain to project acid rock drainage (ARD) potential have been analyzed in a third party technical review and risk assessment. The review concluded that the association of sulphide minerals with calcite, low sulphide concentrations, and the descriptions of pyrite as euhedral would all indicate low total acid production potential and a low rate of oxidation. Additional recommendations for mitigation measures and monitoring (Alternative V) would further lessen project risks.

Introduction

Following release of the draft EIS, the agencies received comments regarding the potential for the project to cause acid rock drainage. The agencies contracted for a technical review and risk assessment regarding acid rock drainage (ARD) aspects of the Rock Creek Project (Klohn-Crippen 1997). The format of the risk assessment was that of a Failure Modes Effects Analyses (FMEA). The FMEA procedure is explained in **Appendix L** of this supplement. In the technical review and risk assessment process all geochemical data regarding the Rock Creek Project and the Troy Mine were evaluated. The reviewers pointed out that the key issue was not acid generation in itself, but rather, drainage water chemistry. As such, the potential for sulphide minerals to oxidize (a process that is different than acid generation) and thereby release metals was also assessed.

ARD is the result of complex chemical and biological reactions. Acid production depends on the amount and type of sulfides, the amount of neutralizing material available in the rock, 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). Drainage from acid-producing rocks typically contains elevated heavy metals that can adversely affect water quality and aquatic life. Potential sources of acid drainage for the proposed project are waste rock that would be stored on the surface and used in tailings embankment construction, ore temporarily stockpiled on the surface and exposed within the mine, and tailings deposited in the tailings storage facility. All these rocks contain some sulfide minerals.

Sulfide mineral oxidation is a process that may occur in pH-neutral conditions and is the probable source of elevated copper in water from the underground workings in the Troy Mine. Other metals could also be released with this process.

There are two general test types used to predict whether or not a particular rock type would turn acid. These are static (acid-base accounting and its several variations) and kinetic (humidity cell, net acid

generation, field) tests. Static tests determine if the ingredients necessary for acid generation (pyrite and other sulfides) are present in sufficient quantities to turn a sample acid, assuming all other conditions are present (Robertson and Broughton 1993). Static tests generally presume that all sulfide minerals would be reactive and that all buffering minerals (calcium carbonate, oxides, feldspars) would be available to buffer acid formation. Static tests are usually conducted prior to kinetic tests because they are relatively inexpensive and quick. Kinetic tests attempt to determine if a sample would turn acid in a controlled weathering environment or under field conditions and usually make actual measurements of sulfate production, pH, and other values over time. Except for the net acid generation (NAG) test, kinetic tests are very expensive and take many months or years to perform.

In acid-base accounting (ABA), the net neutralization potential (NNP) of a sample (the equivalent of [x] tons of calcium carbonate per 1,000 tons of sample) is figured by subtracting the acid generating potential (AP) from the neutralizing potential (NP). A negative (-) NNP value is interpreted to indicate that the sample may turn acid while a positive (+) value indicates that the sample has an excess of neutralization potential and the sample would not turn acid. In a variation on the ABA test, an NP:AP ratio is sometimes calculated. Because there is low reliability in marginal conditions, and it is therefore difficult to interpret marginal ABA values, criteria have been developed to determine if a sample would actually produce acid in the field. For instance, NNP values between +20 and -20 and NP:AP ratios between 3:1 and 1:1 are generally considered to be in a zone of uncertainty. Under these criteria, NNP values greater than 20 and NP:AP ratios greater than 3:1 are considered to be not acid producing, while NNP values less than -20 and NP:AP ratios less than 1:1 are considered potentially acid producing.

These criteria have been shown to be effective in classifying ARD potential so that a rational decision can be reached regarding the need for further kinetic testing (Robertson and Broughton 1993). However, they are guidelines that were developed for situations where there exists at least a moderate acid potential and at least a moderate neutralization potential (A. Robertson, personal communication, January 16-17, 1997). In the case of Revett-type deposits where neutralization potential values are generally low to very low and the acid potential values are lower still, or even zero, these criteria may not be applicable. This is because there is very low risk of acid formation when there is almost no acid potential (Rebecca Miller, personal communication, December 16, 1996).

Prior to release of the Rock Creek Project Draft EIS there were three ABA tests from the Rock Creek deposit, one from Troy Mine tailings, and 156 from within, above, and below the Montanore deposit (61 were waste rock tests conducted during Noranda's Libby Creek evaluation adit construction effort). The Agencies also considered the Troy Mine as a multi-year and continuing kinetic field test. After approximately 15 years since operations began, all affected waters continue to run pH neutral and no other indicators of ARD have been found. Consistent with this assumption, estimates of mine water chemistry from the proposed Rock Creek Mine in this EIS are based upon actual water quality data collected at the Troy Mine.

These data have been supplemented with the results from 55 additional ABA tests. Forty-nine of these were a part of a geochemical study conducted by Montana DEQ called "Geochemical Comparison of Two Very Similar Strata-bound Copper Sulfide Orebodies in Northwest Montana", September 13, 1996. Thirty-three of these samples were from Rock Creek Project drill core (23 from the ore body and 10 from adit-area waste rock) and sixteen were from Troy Mine ore. The other six were from Troy tailings and were conducted as part of ASARCO's paste tailings handling study (ASARCO, October 1996). Additionally, Schafer & Associates, Inc., completed one 26 week kinetic (humidity cell) test of a composite sample of Rock Creek ore comprised of quartzite and siltite from a drill core (ASARCO, April 1996). An ABA and a NAG

test were also performed on the sample taken at the end of the kinetic test. A summary of post-Draft EIS ABA test results is shown in **Table 4-8**.

TABLE 4-8
Summary of Post-draft EIS ABA Test Results for Rock Creek Deposit and Troy Mine Ore, Rock Creek Waste Rock, and Troy Mine Tailings

	Rock Creek Ore	Troy Mine Ore	Rock Creek Waste	Troy Tailings
Average NP	8.2	8.9	7.5	0.9
Average AP	2.2	1.2	2.9	1.3
Average NNP	6.0	7.7	4.7	-0.4
Lowest NNP	-3.0	1.0	0.0	<-0.95
Highest NNP	21.0	20.0	14.0	0.2
Average NP:AP	3.7	7.4	1.6	0.6
Lowest NP:AP	0.4	1.5	1.2	0.02
Highest NP:AP	19.0+	20.0+	5.7	1.2
Number of samples	24	16	10	2*

Notes:
+ indicates sample had an AP value of zero, therefore a true ratio cannot be calculated. The number stated is a minimum value.

* 4 of the 6 Troy tailings sample results are not included because cement was added to the samples, thus increasing their NNP and NP:AP values above what would be expected under natural conditions.

The sample of Rock Creek ore that underwent a 26 week humidity cell test showed low and uniform sulfate levels (except for the initial flush) and neutral pH values throughout the test. The ABA test had a NNP value of 4 and an NP:AP ratio of 2:1 - both within the uncertainty zone. The NAG test, where the sample is aggressively oxidized using a solution of diluted hydrogen peroxide, yielded a pH value of 6.6. A NAG test with a resulting pH of above 5.0 or 6.0 is considered non-acid forming (A. Robertson, personal communication, January 16-17, 1997). Schafer concluded that this sample poses a negligible potential to form acid and the low levels of dissolved metals suggest that metal mobility is not a concern (Schafer & Associates 1997).

In the geotechnical report "Geochemical Comparison of Two Very Similar Strata-bound Copper Sulfide Orebodies in Northwest Montana" (Miller 1996) the Agencies analyzed the geochemistry of the Rock Creek and Troy Mine deposits and their potential for making ARD. The report concluded that Troy Mine and Rock Creek Project rock types are very similar, would be expected to weather similarly, and that because of these strong similarities the Troy Mine can be used as a model for predicting water quality effects of the Rock Creek Project. This conclusion supports the agencies' use of the Troy Mine as a field kinetic test.

Technical Review and Risk Assessment Conclusions

The ARD review in the draft FMEA report (Klohn-Crippen 1997) considered geochemical data that relates to Rock Creek Project tailings, waste rock and ore remaining underground. In regards to field water chemistry, the report concluded that data available (Tables 4.11 and 4.12 of the draft EIS) indicate that there are no significant water chemistry issues at the Troy Mine. While geochemical testing performed to date on the Rock Creek deposit and the Troy Mine is insufficient to demonstrate that there is no potential for net acid generation or metal leaching, the assumption that Rock Creek deposit tailings would not be expected to generate significant net acidic drainage over the long term appears to be reasonable based on the comparison with the Troy Mine and on the relatively low sulfide content of the ore. The association of sulphide minerals with calcite, the low sulphide concentration, and the description of pyrite as euhedral would all indicate low total acid production potential and a low rate of oxidation.

Alternative I

If the proposed project was denied, ASARCO or other companies or individuals may conduct further evaluation of the Rock Creek or other nearby ore deposits. Continued exploration for other metals may occur. These exploration activities could lead to future development of one or more mines.

Alternative II

Geologic Resources

Current ore reserves of ASARCO's Rock Creek deposit are estimated by ASARCO at about 136 million tons at an average grade of 1.65 Troy ounces of silver per ton and 0.68 percent copper, or about 14 pounds per ton. ASARCO's proposed operation would remove approximately 65 percent, or about 88.4 million tons, of the mineral deposit. (This estimate is based on preliminary mine design information. Underground studies may change this figure.) Mining would result in a total production of about 146 million ounces of silver and 1.20 billion pounds of copper. This would increase domestic production of these metals and would have a positive effect on the U.S. gross national product and balance of trade.

Approximately 35 percent of the ore body would remain in the ground; about 30 percent to provide structural support for the mine workings and about 5 percent to protect underground installations and barriers to provide ventilation control. ASARCO's plan also includes maintaining a minimum of 100 feet of rock overburden where the ore body occurs near outcrops. This amounts to a potential unrecoverable resource of up to 78.5 million ounces of silver and 647 million pounds of copper. The ability to recover the remaining ore would depend of metal prices and structural modifications necessary to mine the pillars without loss of structural support. Essentially all the recoverable ore from the Rock Creek ore body would be removed under all action alternatives.

Topography and Geomorphology

Construction of the surface facilities, tailings impoundment, and deposition of adit waste rock for the ASARCO project would alter the existing topography and surface drainage system. The tailings impoundment, mill site, and waste rock dumps would remain as permanent landforms following mining operations. Postmining topography of the impoundment embankment would be uniform and linear. (See **Scenic Resources** for discussion about visual impacts of operating and reclaimed mine facilities.)

Subsidence

ASARCO has not generated analytical rock mechanics data for the Rock Creek site with which to develop their mine plan. These data would be obtained during the construction of the evaluation adit and the twin mine adits, and would be supplemented during operations. Their preliminary underground mine design is based on information extrapolated from experience gained at the ASARCO Troy Mine.

The ore body is exposed to the surface (outcrops) on its southeast and northeast edges (see Figure 4-1 in the draft EIS). ASARCO's plan is to mine no closer than 100 feet from the ground surface (ASARCO, Incorporated 1987-1994) in areas where the ore body outcrops at the surface. ASARCO has identified thick ore horizons (over 150-feet thick) adjacent to the Copper Lake Fault and the Moran Fault at a depth of over 900 feet below the surface. There exists the minor possibility that these areas could experience some surface subsidence under Alternative II if the induced stress field due to mining was larger than the strength of the surrounding rock.

ASARCO has revised the proposed mine plan by committing to not remove support pillars (ASARCO, September 6, 1996). Potential impacts to the ground surface, the ground water system, or to any surface lakes or streams in the area are unknown but considered remote. However, in the remote case that subsidence does occur, there would be the potential to dewater surface or ground water resources. The impact of dewatering cannot be quantified because the location and extent of subsidence cannot be predicted with any accuracy.

For more detailed information regarding the potential of subsidence and related impacts refer to Chapter 4, **Geology**, and Appendix E in the draft EIS.

Slope Stability

There is some potential for slumping related to proposed construction (primarily cutslopes) of the new segment of FDR No. 150 on lacustrine silts and clays near Montana Highway 200 and of the mine adit access road in some steep areas on residual soil (see **Soils**). If slumping were to occur due to placement of access roads, potential for erosion and sediment yield would increase.

Acid Rock Drainage Potential

Waste rock excavated to develop the exploration (evaluation) adit and service adits would be quartzites, siltites and argillites of the Revett Formation that have a very low potential to form acid. Ore remaining in place underground and tailing placed on the surface would be quartzites and siltites. Analyses suggest that exposure of Rock Creek ore and waste rock by mining would not likely generate acidic mine water. Likewise, tailings would have a very low potential to generate acidic water. These conclusions are valid for both the short term and the long term. The ability of near neutral pH adit water to leach significant levels of metals would also be low.

Nonetheless, uncertainty exists. Additional kinetic and ABA tests would be performed during the construction of the evaluation adit to ensure that the adit and excavated material were not acid generating. In addition, water treatment contingency mitigation would be a highly sophisticated treatment process; one not typically implemented at mining operations. If adequately sized and operated, it is a very effective water

treatment process and should be sufficient to address any water quality issues during operations (Klohn-Crippen 1997).

Alternative III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Geologic Resources

If pillar sizes were increased or areas of deposit restricted from removal, there would be a reduction in the amount of geologic resources mined by the proposed project. A reduction in ore recovery would result in a greater amount of ore being left unmined and less tailings would be generated. Secondary impacts would result to ASARCO because revenues from the project would be reduced.

Topography

Under Alternative V, post mining topography of the tailings paste facility would appear more natural than under any of the other action alternatives due to the paste design and reclamation plan that would allow for more slope curvature and variety. While this would be true for all three Alternative V options, there would be differences in the final topography under each of the options.

Subsidence

ASARCO would be required to provide the Agencies with an updated underground mine design and rock mechanics studies within 2 years of operation (mill start up), as well as in advance of entering areas of suspected instability (see Figure 4-1 in the draft EIS). ASARCO has modified the mine plan by dropping their option to remove support pillars. The Agencies' underground design reviews would effectively preclude subsidence or other surface effects related to mine-induced fracturing such as might occur under Alternative II. These mitigations could require that ASARCO leave more ore in the ground for support. The amount of additional ore left underground would amount to several percent or less, however the amount cannot be precisely determined until mining is underway. Nonetheless, should subsidence occur in the mine area, the consequences at the surface would be significant.

Slope Stability

This alternative would involve relocation of FDR No. 150 and elimination of ASARCO's proposed mine portal access road, thus precluding potential slope failure as discussed under Alternative II.

Acid Rock Drainage

Additional monitoring and mitigation measures were recommended after the technical review and Failure Modes Effects Analysis (risk assessment) that was conducted on ARD and geochemistry data. Alternative V contains these additional monitoring (see Appendix H) and mitigation measures and would

further define and help reduce the potential for ARD and metals leaching from ore, waste rock, and tailings over those of any of the other action alternatives. This would include a geochemical testing program to begin during construction of the evaluation adit and to continue throughout mine operation.

Cumulative Impacts

Both ASARCO and Noranda would mine stratabound copper-silver deposits from metasedimentary rock in the CMW. Estimated minable reserves for the two projects total 163 million tons of ore. The mineral deposits are sufficiently isolated from each other that no cumulative subsidence or related water impacts are expected.

Construction and operation of both mines would likely result in more stringent requirements on other minerals activities in the area in order to ensure sufficient undisturbed habitat for several wildlife species. The result would be a slowdown in potential mineral exploration and permitting of potential future mineral developments in the area during the life of these projects.

GEOTECHNICAL ENGINEERING

Summary

The use of paste technology for tailings disposal is a relatively new development in the mining industry as a means for waste management. The use of this technology, however, mitigates several issues related to a "wet" disposal system as is proposed for alternatives II through IV. Specifically, by using tailings which have been partially dewatered, issues pertaining to liquefaction and seepage are substantially reduced. The use of paste would change the tailings impoundment from a water retaining-type structure to one exhibiting characteristics of a large constructed embankment.

Paste tailings would improve the overall strength of the tailings medium, and with this a decreased susceptibility to impoundment failure from seismically induced liquefaction. A risk assessment employing the Failure Modes Effects Analysis (FMEA) protocol was conducted for Alternative V. This process identified potential failure modes, likelihood of occurrence, the environmental consequences associated with these events, and possible mitigations to reduce the likelihood of the occurrence.

Alternative I

The risk of an impoundment failure and associated impacts would not exist.

Alternative II

Alternative II would involve an upstream tailings impoundment as proposed by ASARCO. This alternative addresses the four potential failure mechanisms as follows:

> **Foundation Sliding**. Soft clay deposits tend to slip if they are loaded too quickly for the water in the clay to drain away. Alternative II proposes to use a slow rate of loading and "wick drains" to enhance water drainage in the clay.

Seepage-Induce Piping. Piping tends to happen if the water seeping from inside the dam reaches the downstream face of the dam. Alternative II proposes a combination of free-draining starter dams and blanket drains to intercept seepage water before it could reach the face of the dam. Intercepted seepage water would be collected and pumped back to the impoundment.

Overtopping. Alternative II proposes diverting upgradient runoff from all precipitation events up to a PMF around the facility and having enough water storage to hold a PMF that might fall on the impoundment. However, for the first 3 years of impoundment construction, containing the PMF would require the water to move closer to the dam crest than the 200-foot distance given as the minimum operational distance in the design. This encroachment would increase the risk of seepage-induced piping.

Earthquake-Induced Liquefaction. The upstream method of construction proposed for Alternative II is typically susceptible to earthquake-induced liquefaction. ASARCO has committed to a final design process that would include detailed laboratory testing and verification of the liquefaction resistance of upstream-placed tailings, and monitoring of the placed tailings density to address susceptibility to liquefaction. Alternative II would include a life-of-mine construction monitoring plan with formal reports to the Agencies and periodic performance reviews by experienced professional engineers.

Foundation slippage and seepage-induced piping can be adequately addressed with ordinary construction methods, and the risk associated with overtopping is acceptable. However, the level of information available regarding liquefaction resistance did not support preliminary approval (during application completeness reviews) of an upstream facility.

Agency concerns focused on the peak shear strengths of the clay foundation soils, the assumed densities of the in place tailings, and the appropriate seismic evaluation criteria to be used. In response to Agency concerns, ASARCO developed an alternative design for the tailings impoundment which included a combination upstream and centerline design approach known as a “modified centerline” method. This modification in impoundment design was a principal change under Alternatives III and IV. While the impacts from a tailings impoundment failure would be significant if it occurred for Alternatives II - IV, the level of risk of occurrence under the Alternative III and IV impoundment design would be acceptable to the Agencies, but the level of risk of occurrence for Alternative II would not be acceptable.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2; Part V: Comparison of Alternatives**.

Alternative V

Failure Mechanisms

In addition to the four previously identified failure mechanisms for the "wet" tailings impoundment as identified in the draft EIS (foundation sliding, seepage-induced piping, overtopping, and, earthquake-induced liquefaction), two additional failure mechanisms are included for Alternative V: surface erosion, and paste collapse.

Foundation Sliding. Soft clay deposits beneath the tailings paste facility could slip under the weight of the overlying paste, and could potentially threaten the stability of the embankment. As proposed in Alternatives III and IV, the soft clay deposits would be removed under Alternative V, thereby reducing the probability that there would be a foundation failure.

Seepage-Induced Piping. The physical character of paste (well graded material) would be an effective deterrent to piping. The permeability of the paste would be also sufficiently low that migration of free water is negligible. However, if the paste realized a significant increase in moisture content or an increase in the elevation of phreatic surface, it is conceivable that conditions for piping could begin. A strict QA/QC plan and monitoring program would identify any of these conditions long before they reached a critical point.

Overtopping. There would be no free water surface in a tailings paste facility. The proposed design calls for a construction sequence which does not include a water retention feature. Any ponded water from excessive rainfall or snowmelt would either seep into the paste or be directed offsite. Overtopping would not be possible.

Earthquake-Induced Liquefaction. The threat of liquefaction would be greatly reduced with a paste facility due to inherent paste strength and a reduced phreatic surface. While the paste would be capable of liquefying during a seismic event, design features such as a compacted shell and foundation drains would greatly reduce this risk.

Surface Erosion. While the paste facility may not be susceptible to overtopping, the embankment surface may be prone to surface erosion. While erosion would not present a catastrophic threat to the stability of the embankment, it could present a chronic on-going maintenance problem. In addition to erosion, small localized slumps might occur from over saturated areas, again, there would be no threat to the overall stability, rather these type events would require an ongoing maintenance commitment on the part of ASARCO.

Paste Collapse. Preliminary laboratory testing suggests that the paste may exhibit characteristics similar to those of collapsible soils. Should the moisture content in the paste become elevated beyond its optimum, there could be a build-up of pore pressure within the paste and ultimately deformation of the paste pile. Again, this would not occur on catastrophic proportions or pose an environmental threat, rather it would present a maintenance problem which if left unchecked could eventually cause an environmental impact from the erosion and redeposition of paste material.

Stability Analysis

An analysis of the stability of the Alternative V paste facility indicates that either the Top-Down or the Bottom-Up design option would be stable under normal operating conditions as well as when subjected to the design earthquake, provided under-drains are included in the design**.** The analyses were conducted by modeling the paste facility at the end of mine life when the facility would theoretically be in the least stable condition. Stability analyses were run for static conditions (no external forces other than gravity), for conditions during the design earthquake, and finally for conditions immediately following a seismic event. Using varying water infiltration rates (from rainfall) and the presence or absence of under drains, the factor of safety for all paste construction options under static conditions ranged between 1.2 and 2.0; for the maximum estimated seismic event the factor of safety was found to range between 0.9 and 1.35. (Note: A factor of safety > 1.0 implies a structure is not subject to failure from the applied forces.) The 0.9 value was for the Top-Down configuration without under drains and experiencing 20 inches per year of water infiltration into the paste pile. The seismic modeling suggests that Bottom-Up construction would provide a more stable facility. This is due to the embankment having a compacted outer shell which provides a resisting buttress for the remainder of the impoundment. By inference, the combined Bottom-Up/Top-Down design could also provide improved resistance to failure due to the compacted outer shell of the Bottom-Up component.

In all of the design options, it will be imperative to provide adequate foundation drains to ensure against a phreatic surface build-up within the paste. An increase in the elevation of the phreatic surface within the paste embankment can lower the resistance to liquefaction in the event of an earthquake. Increased moisture content can also change the character and hence the behavior of the paste tailings. Tailings paste usually has a moisture content within the range of 20% to 25%. If the moisture content of the paste increased appreciably, it is conceivable that the stability of the paste embankment would be reduced. Localized increases in moisture content due to production problems, prolonged rainfall or snowmelt infiltration could create discrete areas of softer paste which perhaps could exhibit a reduction in strength, however, there would need to be a significant increase in moisture content throughout the entire paste deposit before the overall stability of the impoundment would be compromised. Areas of elevated moisture in the paste could lead to areas of paste collapse, slumps along slope faces and localized mud-like flows. Occurrences such as these would not compromise the overall stability of the paste facility, rather they would create ongoing maintenance and repair liabilities during operations and post-closure.

Risk Analysis

A risk assessment was conducted for Alternative V (Klohn-Crippen, 1997) using the Failure Modes and Effects Analysis (FMEA) protocol, a quantitative process which is intended to identify and characterize risks associated with the design and performance of engineered systems (see **Appendix L**). The risk assessment was limited to an analysis of the Top-Down and Bottom-Up designs, and considered these systems' performance for a period of 1000 years.

Impacts associated with a dam failure include the potential contamination of ground and surface water, and the associated impacts on aquatic life. However, if a slope failure were to occur, the mass evacuation of the paste from the impoundment would not be expected. Since the tailings have the consistency of a paste with relatively little free water available, a mass failure would not produce the kind of fluid flow that could be expected with tailings from a wet tailings impoundment where the tailings have little to no shear strength. Tailings discharge from a failed paste embankment would be minimal, probably localized in a small area, and not likely to reach the Clark Fork River or Rock Creek. There would not be the complete

evacuation of retained material as one might expect should a water retention dam fail. However, as the moisture content of the paste increases, say from excessive precipitation or an elevation of the phreatic surface within the tailings pile, the more likely it is for the paste to flow greater distances in the event of a failure.

The Failure Modes Effects Analysis looked at a complete failure of the paste facility nonetheless. The likelihood of dam failure of the paste pile with underdrains under seismic loading for the Bottom-Up design was assigned a likelihood of occurrence of 1 in 10,000 to 1 in 1,000,000; the likelihood of occurrence for the Top-Down approach was estimated at a 1 in a 100 chance to 1 in 10,000 chance. The consequences associated with a failure in both instances were designated as "high" to "extreme", which are defined as "short term irreversible impact, long term excursion of water quality", and "catastrophic event, long term impact" respectively. The socioeconomic impacts associated with a dam failure were estimated as "extreme" which was defined as an event garnering international scrutiny and a mitigation cost of in excess of $10 million.

Despite the estimated consequences associated with such an occurrence, there are several mitigating measures which can be implemented to reduce this risk of a dam failure. These include: employ the Bottom-Up construction sequence; install blanket and finger drains beneath the impoundment; continually model and monitor the moisture content of the paste pile during operations to better understand saturation levels; generate a detailed design of the paste plant operations and disposal system to ensure quality assurance and quality control during operation and post-closure. With these compensating factors fully employed, the FMEA analysis estimated the likelihood of dam failure under the Bottom-Up option as "negligible" (< 1 in 1,000,000 chance of occurring), and the confidence associated with this was considered "high".

Alternative V also includes a technical panel review of all phases of the final design prior to design approval and construction. Issues previously identified as part of alternatives II through IV, and which are germane to Alternative V as well, including foundation sliding, piping, liquefaction and embankment erosion can be addressed during the peer review and through a comprehensive quality control program as part of paste milling and impoundment construction. Strict moisture content control during processing and placement will be required if the paste is to exhibit the physical characteristics which were modeled as part of the stability analyses. As part of Alternative V, the Agencies would require ASARCO to submit a Quality Assurance and Quality Control (QA/QC) program for paste milling, paste placement and impoundment management so as to keep the paste within design tolerances.

SOILS AND RECLAMATION

Summary

Impacts on the soil resource under all action alternatives would be similar and would include loss of soil characteristics developed over 10,000 years. Recognition of these inherent soil properties and design of salvage and handling programs to minimize the loss of the soil properties can enhance reclamation success.

Soil impacts resulting from any of the action alternatives typical of any operation where soil is removed, stored and replaced would include 1) loss of soil development and horizonation; 2) soil loss from wind and water erosion and equipment handling; 3) changes in soil physical properties, 4) reduction in biological activity; and 5) changes in nutrient levels. Mine wastes used as subsoil and even some native subsoils may contain elemental concentrations of potentially harmful metals that could affect plant growth.

Soil development losses and site productivity reductions would be long term, primarily in the tailings impoundment/paste facility area. Modifications and mitigations proposed by the Agencies would minimize these impacts. In turn, the potential for reclamation success would be improved and mitigation of impacts identified for other resources would be enhanced by reclamation plan changes proposed by the Agencies. Overall impacts under Alternative V would be less than alternatives II, III, and IV as summarized below.

Alternative I

Soil resource impacts would be limited in comparison to the other alternatives. Erosion and sedimentation would increase in the Rock Creek drainage by some amount as a result of proposed Forest Service and private timber harvests, new road construction, and development of other private land (See **Hydrology**). Existing sediment loading from the unpaved Rock Creek roads would continue to impact Rock Creek unless more sediment reducing Best Management Practices are implemented. Existing impacts from sediment in Rock Creek are discussed in the **Hydrology** and **Aquatics/Fisheries** sections.

Loss of soil development characteristics would be minimized and would only occur in the limited new disturbances envisioned for the area in the reasonably forseeable future. Logging would not completely destroy soil horizonation, and would not completely alter soil physical properties, soil biological activity and soil nutrient levels like tailings impoundment or mill and mine waste rock dump construction.

Alternative II

Soil Impacts

Soil losses from erosion and handling, impacts to physical characteristics when soils are disturbed, reduced soil biological activity and soil nutrient levels, increased metal contents in the reclaimed rooting zone from natural subsoil accumulations in forest soils as well as metal contents in the various mine wastes were discussed and evaluated in the draft EIS for all phases of construction, operation and reclamation on 584 acres that would be disturbed in the proposed action.

Soil losses from the company's proposed plan would exceed the levels that would occur under the no-action alternative, Alternative I. Soil losses within the disturbed areas would exceed acceptable limits of two tons/acre/year on all disturbed areas until interim seeding is in place or the roads are paved. Best Management Practices including sediment control ponds, silt fences, etc. would limit impacts to off site areas including Rock Creek. ASARCO's proposed measures to control runoff and sediment combined with native topsoil and subsoil characteristics, such as rock fragment content, would help reduce erosion rates. Roads that are proposed to be paved would greatly reduce erosion on those roads compared with the no-action alternative, Alternative I. Until vegetation cover reached predisturbance levels, which usually takes 3 to 5 years, erosion rates on non-paved areas would be higher than before disturbance and would exceed the 2 tons/acre/year soil loss threshold. The impacts on aquatic life from soil loss off site due to erosion are discussed in the **Hydrology** and **Aquatics/Fisheries** sections. The Agencies have concluded that soil losses within disturbed areas would not be a matter of concern because excess soil exists to meet the company's proposed reclamation plan.

Soil physical characteristics would be substantially altered in any of the action alternatives when compared to the no-action Alternative I and are detailed in the draft EIS for major disturbance categories. Most of this physical alteration is unavoidable in any disturbance scenario. The company has proposed a

standard soil salvage and handling plan. The amount of direct haul soil salvage and replacement is limited under Alternative II, especially in the impoundment footprint. The changes in soil physical characteristics would limit the ability of the soil to begin redevelopment when replaced on reclaimed lands. The greatest impact would be on the south and west faces where the proposed limited soil replacement depth combined with a warmer and drier microclimate and steeper, more erodible slopes would limit plant community development. In the long term, soil redevelopment processes would begin to alter the underlying tailings beneath the soil.

Soil biological activity would be reduced in the disturbed soils. Most soils would have to be stored for up to 30 years of mine life. This loss of soil biological activity would slow the recovery of plant communities on reclaimed areas. In the long term, this impact would decrease as soil biota began to reestablish in the developing soil profile.

Soil nutrients would also be reduced in the soil removed from acres to be disturbed. This impact is less important in the long term as organic matter becomes incorporated in the soil profile.

Metal contents in the reclaimed rooting zone would be increased by the soil salvage and handling program. In a forested environment iron, manganese, and aluminum can accumulate in the lower portions of the soil profile. Native plants are adapted to this phenomenon. Any soil disturbance, including logging activities, can mix these metals and redeposit them in the surface of the disturbed soil profile. The Agencies have concluded that the metals contents present do not represent a major impact to reestablishment of vegetation on the disturbed lands.

Reclamation Impacts

The discussion in the draft EIS focused on soil salvage and handling, revegetation, and the degree to which successful reclamation may be achieved for the various types of disturbances. Various soil properties limiting reclamation potential were identified above in the **Soil and Reclamation** section.

Impacts resulting from soil salvage and handling would be greatest in the short tem but potentially noticeable in the long term because of the time needed for the site to achieve the aesthetic considerations and comparable stability and utility determinations. The effects under Alternative II would be obvious because inadequate soil replacement depths would limit productivity and reclamation success especially on the south and west facing slopes of the tailings impoundment.

Scheduling of final revegetation, species selection, planting plans, establishment success, and growth rates needed to achieve cover and height objectives determine the speed and success of restoring disturbed lands to comparable stability and utility. The loss of soil biota, soil organic matter, and the long term soil storage discussed above would also delay successful final reclamation.

Results of the proposed revegetation program, especially the tree and shrub planting plan, would extend the time needed to meet visual screening and comparable stability and utility objectives in the short term. These impacts would decrease over time as soil redevelopment would overcome the restrictions imposed by limited soil quality and quantity.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Soil Impacts

Impacts to the soil resource would be similar to those identified under Alternative II as well as alternatives III and IV in the draft EIS with the following exceptions. The total disturbance area listed in Table 2.1 has been reduced in Alternative V to 483 acres mainly by changes in borrow areas, soil stockpiles, powerline and mill facility disturbances. This is 101 acres less than Alternative II, 126 acres less than Alternative III, and 60 acres less than Alternative IV. In general, less disturbance equates with less soil impacts.

Soil Loss

Soil loss from the proposed project facilities would be essentially similar to Alternatives II, III, and IV except in the paste facility area. The potential for soil loss in Alternative V in the tailing paste facility area is reduced because less soil has to be stripped in advance as compared to the typical tailing impoundment soil stripping program. The tailings impoundment alternatives II, III, and IV would require the entire footprint of 324 acres stripped in advance, leaving the disturbed areas and all soil stockpiles subject to erosion. This is potentially important because the most erosive soils in the area are the lacustrine soils found in the paste facility footprint. Less disturbance equates with less soil loss.

In addition, ASARCO has proposed a concurrent reclamation plan as major stages of the paste facility are completed, beginning in year 7 of the project. As proposed, the Bottom-Up construction option would not have any portion of the paste facility at final grade until year 20. In contrast, the Top-Down construction option begins to have areas at final grade in Year 7. The Bottom-Up option has an area of maximum disturbance of 190 acres in Year 19 (Bill Thompson, pers. comm. to Nancy Johnson, DEQ, August 29, 1997). In contrast, the Top-Down option has a maximum area of active disturbance of 121 acres in Year 26. The combined option would have variable acreage depending on which method is being used at the time. As an Agency mitigation, ASARCO would be required to reclaim any portions of the paste facility that are at final grade each year. The final engineering design plans for the paste facility should allow ASARCO to deposit the paste to the approximate final grade and minimize regrading at a later date. This allows for more aggressive concurrent reclamation on an annual basis.

This reduction in acres disturbed at any one time limits soil losses operationally within the paste facility footprint. In addition, less areas are in soil stockpiles. Soil losses after reclamation of the paste facility using the Bottom-Up option would be less than the tailings impoundment in Alternatives II, III, and IV even though the current conceptual design for the Bottom-Up option produces an ultimate configuration that is essentially the same as the impoundment with a 3H:1V outer slope and essentially the same number of sloped versus flat acres. Ultimate soil losses would be less because the concurrent reclamation schedule limits the acres of active disturbance and allows more acres to be reclaimed with direct haul soil which enhances reclamation success. Concurrent reclamation using the Top-Down option would limit soil losses even more because the ultimate slope is 5H:1V rather than 3H:1V. If the Bottom-Up option could be designed with flatter slopes to more closely resemble the final configuration of the Top-Down option, soil

losses would be similar to the Top-Down option. The combined option would produce potential soil losses between the other two extremes.

In addition to reduced soil losses from less disturbed acres and more concurrent reclamation, ASARCO would have to apply soils of varying quality on different slope angles. The lacustrine soils which are the most erosive, could only be placed on slopes less than 8 percent and that are not in drainageways. Colluvial, alluvial, and lacustrine soils mixed with specific rock contents would be used on slopes greater than 8 percent (see the **Reclamation of Tailings Paste Facility** section for Alternative V in **Chapter 2**). ASARCO would need to conduct a detailed soil survey to ensure that enough soil materials exist to complete the reclamation with appropriate materials and to ensure there is enough materials available to construct the toe buttresses.

In summary, soil losses within the footprint of the disturbances proposed in Alternative V would be less than Alternatives II, III, or IV. The Agencies have concluded that enough soil exists within the footprint of the tailings impoundment site to complete the reclamation as proposed by the Agencies in the modified reclamation plan. Losses of soils within the footprint would be captured by sediment and erosion control Best Management Practices reducing soil loss impacts to short term acceptable limits. Long term losses would be less than the 2 tons/acre/year soil loss threshold needed for successful reclamation. Impacts from any soil loss off the disturbance acreage is discussed in **Hydrology** and **Aquatics/Fisheries**.

Other Soil Impacts

The same factors listed above that reduce soil losses in Alternative V, also reduce impacts to soil physical characteristic, soil biological activity and soil nutrient levels. This would produce greater reclamation success as soil redevelopment would be accelerated as a result. Soil would not be in stockpiles as long as in Alternatives II, III and IV. The initial soil stockpiles should be used to reclaim the first acres of disturbance that reach final grade. Additional soil stockpiles needed operationally could be placed on the portions of the completed tailings deposit.

Reclamation Impacts

Reclamation impacts from soil salvage and handling and the revegetation plan would be similar to those identified in Alternatives III and IV in the draft EIS with the following exceptions.

The pipeline corridor reclamation has been enhanced by covering the pipeline with 24 inches of soil. The majority of the pipeline would then remain in place at closure and reclamation would be considered final on the majority of the pipeline route. This would enhance reclamation potential and allow trees to establish over the mine life enhancing the revegetation and therefore the aesthetics of the pipeline corridor. The double-walled pipe proposed limits the chances of tree roots affecting pipeline performance over the 30 year mine life.

The reclamation of the tailings paste deposit would be enhanced by operational practices described in the soil impacts section above. Soil loss would be limited by less disturbance overall. Soil stockpiling would be limited; whenever possible the oldest stockpiled soil would be used first and more soil could be direct hauled. This would increase soil biological activity, minimize impacts to soil physical characteristics, and soil nutrients. Reclamation and subsequent revegetation potential would be increased as a result over the other action alternatives.

The paste deposition process would allow for the addition of seed, fertilizer, organic amendments, cement and other additives as needed operationally to control erosion, enhance stability, or to enhance reclamation as final design contours are reached. The Agencies would require that the reclamation plan contain provisions to include appropriate amendments to the tailings paste to adequately control erosion and facilitate interim and final reclamation. The paste deposition process also allows selective placement and regrading to create topographic variation in the final design features. ASARCO would be required to submit regrading and more detailed revegetation plans for all mine facilities for Agencies' approval. All of the features inherent in the paste deposition process would lead to better reclamation on the proposed disturbance areas improving the visual appearance and revegetation potential over the tailings impoundment alternatives II, III, and IV.

Overall reclamation impacts to soils and revegetation would be minimized in Alternative V when compared to impacts in Alternatives II, III, and IV.

Cumulative Impacts

Cumulative impacts to the soil resource primarily would be associated with potential soil loss. On site erosion within the disturbed areas would be controlled with Best Management Practices. Off site erosion would increase sediment to Rock Creek as discussed in the **Hydrology** and **Aquatics/Fisheries** sections. If proposed erosion mitigations are properly implemented and maintained, on-site erosion and, in turn, the potential increase in sedimentation to Rock Creek would be minimized. Proposed future disturbances on public lands in the area would require Best Management Practices to control future additional sediment loads to Rock Creek. Private land activities in the area generally do no have the necessary amount of Best Management Practices applied to adequately control sediment. More acreage in the permit area would be unproductive due to the 481 acre increases in disturbances including roads and other paved or graveled surfaces, however this additional loss is not expected to affect the overall productivity in the region. Other developments associated with private land development in the region as a result of population increases spurred by development of the proposed project, the Montanore project and the general increase in the population in the area could reduce the long term productivity of the region in terms of timber production and wildlife habitat (see **Biodiversity**).

HYDROLOGY

Summary

The proposed adits, underground mine, mill facility, utility corridor, waste rock dump, and the tailings facility (impoundment or paste facility) would have the potential to affect surface and ground water resources under all action alternatives. Hydrologic effects would include changes in water availability and water quality.

Total ground water inflow to the evaluation adit is estimated to be about 168 gpm. Inflow to the conveyor and service adits would be about 228 gpm. Inflow to the underground mine is estimated to be about 1,650 gpm. Total inflow to the underground workings and adits would equal about 2,046 gpm. The quality of mine inflow would be affected by blasting activities increasing concentrations of nitrogen, ammonia, suspended solids, and metals. Excess mine water would be temporarily stored underground, and would be treated to remove suspended solids, metals, and nitrogen prior to discharge via a pipeline to the Clark Fork River. The impact of treated discharge on the quality of water in the Clark Fork River in

Montana and Idaho would not be measurable due to the low concentration of constituents in the treated effluent and the relatively higher flow available for dilution. After mining had ceased, excess mine water would continue to be treated until it eventually met MPDES effluent limits. Eventually the mine adits would be plugged and mine water would collect in the underground workings.

Two wilderness lakes in the CMW overlying mined-out portions of the mineral deposit could potentially be affected if faults or fractures acted as ground water conduits, and ASARCO's pilot hole testing and grouting programs were ineffective. As a result, water levels in lakes and surface outflow from the lakes might be reduced. The potential for this to occur is remote. The Agencies' requirement for additional rock mechanics studies in alternatives III through V would further reduce the risk of subsidence-related draining of these lakes. Water occupying fractures in rock above the operating level of the mine could be lost to mine inflow.

After mining was complete and the adits were sealed, the mine would fill with water until steady state conditions were reached. At steady state, inflow to the mine would equal outflow. The total volume of flow underground cannot be quantified, but should be relatively low due to low bedrock permeabilities. If there is outflow, it is uncertain where outflow from the mine would discharge. If access adits were not sealed, excess mine water could be discharged to surface waters only if it could meet effluent limits of the receiving waters..

Make-up water from a well located in the Clark Fork River alluvium would be required if mine adit and tailings reclaim water could not provide all water needed to maintain mill operations. The impact of the proposed withdrawal would not significantly affect existing instream flows or existing beneficial uses of the Clark Fork River or ground water.

Ruptures or breaks in either the proposed tailings slurry or return water lines, or an accidental rupture of a supply or tanker truck could result in short-term water quality impacts to Rock Creek. The potential of tailings pipeline ruptures and spills in the West Fork Rock Creek are eliminated under alternatives IV and V. The potential for pipeline rupture and spills to Rock Creek are greatly reduced by burying the pipeline under Alternative V. The effect that spills and ruptures would have on the overall water quality of Rock Creek cannot be predicted with certainty.

Depending on weather conditions and the efficiency of best management practices used, sediment and nitrogen loading to Rock Creek below the proposed mill site could temporarily increase during project construction. The concentration of total suspended solids (TSS) in Rock Creek would probably not exceed 20 milligrams per liter (mg/L). The amount of sediment would be reduced under alternatives III through V due to mitigations, including reduction of existing sediment sources in the drainage. The increase in the concentration of nitrogen in Rock Creek cannot be estimated with certainty, and would depend on several factors. Research suggests that the impacts of leaching soluble nitrogen in waste rock would be short lived. All nitrogen compounds would probably be leached out within one month to one year (British Columbia Ministry of the Environment 1983). Under Alternative V, seepage from the mill pad would be collected in an underdrain and routed to the mill for reuse. This action would reduce nitrate loading to Rock Creek.

Development of a tailings facility under all action alternatives would alter more than 300 acres of natural watershed in the Miller Gulch drainage. Surface water runoff in Miller Gulch would decrease during the life of the project, and would likely return to near normal after reclamation.

Under alternatives II, III, and IV, seepage from the proposed tailings impoundment to ground water within the ground water mixing zone could approach several hundred gpm by the end of the 30-year mine life. Seepage water quality from the impoundment would likely be similar to impoundment seepage water quality at the ASARCO Troy Mine, and would affect ground water quality within a ground water mixing zone permitted by DEQ (see ARM §17.30.1802(6) for the definition of a mixing zone). An engineered perimeter drain and ground water extraction well system would pump seepage water back to the tailings impoundment, and would prevent changes in ground water quality outside of the mixing zone, or would prevent discharge of tailings impoundment seepage to Rock Creek, Miller Gulch, and the Clark Fork River. Continued monitoring of a series of tailings impoundment compliance wells would minimize or possibly eliminate the potential for seepage to migrate outside the mixing zone. Under Alternative V, seepage from the proposed paste facility would be approximately 20-30 gpm. An underdrain, seepage collection system, and an approved mixing zone would still be required.

Under alternatives II, III, and IV, after the tailings impoundment was reclaimed, seepage from the impoundment would decrease, and the impoundment would dewater over several decades. Therefore, the perimeter seepage collection system would potentially need to be operated and maintained for alternatives II through IV, and ground water would be monitored for several decades for all action alternatives. Under Alternative V, the 20-30 gpm seepage rate would decrease substantially after reclamation.

Under alternatives II, III and IV, sediment and tailings leachate would be uncontrollably released to the environment in the unlikely event of catastrophic failure of the tailings dam. The volume of material released and the effect of this release on the environment cannot be predicted, and would depend on the type of failure, the size of the tailings impoundment at the time of failure, the volume of water associated with the failure, and the initial volume and character of the sediments. During a failure, sediment and tailings water could flush into Rock Creek and the Clark Fork River. Portions of this sediment mass would probably remain in these stream channels for an undefined period of time following failure, while tailings water and the remaining sediment would be carried downstream. Subsequent to any such failure seasonal high flows would continue to wash most of the remaining sediment downstream, and eventually the sediment would be stored in Cabinet Gorge reservoir upstream of the dam. Fine sediments from any such catastrophic failure would probably persist in the Rock Creek system for decades. Tailings water and sediments would eventually enter Lake Pend Oreille. Because of the volume of the lake water available for dilution, it is unlikely that changes in concentrations of dissolved or total recoverable metals, or nutrients would be measurable in the long term. Short-term effects temporarily could impair some beneficial uses such as domestic water supply. Under Alternative V, the probability of catastrophic failure would be substantially reduced. Failure modes such as paste collapse would pose a maintenance problem that would require remediation to avoid potential environmental impacts to surface water resources.

Introduction

Water Quality Standards

Montana's surface water standards, shown in **Table 4-9**, are a combination of drinking water, aquatic life, and water and fish ingestion numeric standards (Circular WQB-7, December 1995 edition) and the prohibitions discussed in ARM §17.30.633. In implementing these standards, DEQ requires analysis of total recoverable metals. DEQ will base effluent limits and other conditions of the ASARCO

TABLE 4-9
Montana and Idaho Water Quality Standards in Milligrams per Liter (mg/L)

	Montana Ground Water (Dissolved Analyses)			Montana Surface Water [h,+] (Total Recoverable Analyses)			Idaho Surface Water (Dissolved Analyses)
	Water Quality Standard	Trigger Value[t]	Revised draft MPDES Permit Ambient Standard	Water Quality Standard	Trigger Value	Revised draft MPDES Permit Average Monthly Limit (lbs/day)	Water Quality Standard
pH (SU)	N/A	N/A	NS	6.5-8.5	N/A	N/A	6.9-9.5
Total Hardness (as $CaCO_3$)	N/A	N/A	N/A	N	N/A	N/A	N
Total Alkalinity (as $CaCO_3$)	N/A	N/A	N/A	N	N/A	N/A	20.0S
Sulfate (SO_4)	N/A	N/A	N/A	N	N/A	N/A	N
Ammonia (NH_3 as N)[¶]	N/A	N/A	N/A	1.3*	0.01	N/A	¶
Total Kjeldahl Nitrogen (as N)	N/A	N/A	N/A	N/A	N/A	N/A	N
Nitrate and Nitrite (as N)	10	2.5	10	10	0.01	N/A	N
TIN	N/A	N/A	N/A	N	N/A	193.4	N
Orthophosphate (PO_4-P)	N/A	N/A	N/A	N	N/A	N/A	N
Total Phosphorus	N/A	N/A	N/A	0.02	0.001	N/A	N
Arsenic	0.018	N/A	0.018	0.018	N/A	0.0075	0.0062
Cadmium[+]	0.005	0.0001	0.005	0.001[h]	0.0001	0.994	0.00085[h]
Chromium VI	0.10	0.005	N/A	0.011[h]	0.005	N/A	0.01045
Copper[+]	1.0	0.0005	1.0	0.010[h]	0.0005	0.414	0.0085[h]
Iron	0.3	N/A	N/A	0.3	N/A	N/A	N
Lead[+]	0.015	0.0001	0.015	0.003[h]	0.0001	0.994	0.00065[h]
Manganese	0.05	N/A	0.05	0.05	N/A	69.0	N
Mercury	0.00014	N/A	0.00014	0.000012	N/A	0.0014	0.000012
Selenium	0.05	0.0006	N/A	0.005	0.0006	N/A	0.005
Silver[+]	0.05	0.0002	N/A	0.003[h]	0.0002	20.7	0.00255[h]
Zinc[+]	5.0	0.005	5.0	0.093[h]	0.005	N/A	0.0791[h]

Source: Circular WQB-7 (December 1995 edition); ARM 17.30, sub-chapter 6; ARM 17.30.1003 et seq.; ARM 17.30.203; and Idaho DEQ 1995.

SU = Standard pH Units
t = Trigger values are used to determine whether or not a given increase in the concentration of parameters is significant or non-significant as per the non-degradation rules ARM §16.20.707(23)
¶ = pH and temperature dependent; value shown is calculated for 10°C and pH = 8.0. MT and ID standards are equivalent.
h = Standards based on Hardness = 85.7 mg/L and is the more restrictive of the human health or aquatic life standards.
N/A = Not Applicable NS = Narrative Standard
TIN = Total Inorganic Nitrogen
S = Minimal acceptable value except in waters which are naturally lower
N = Narrative standards (see ARM §16.20 or State of Idaho regulations)
* = Personal communication with Tom Reid, Montana DHES, June 18, 1995.
= Table values are based on chronic freshwater aquatic life criteria with the following exceptions: (MT and ID) Arsenic -human health criteria; Silver - acute freshwater aquatic life criteria; (MT) Manganese and Iron - human health criteria. Table values are the most restrictive standards of each state. Idaho standards for metals are dissolved concentrations; exceptions are mercury, selenium, and arsenic.
+ = At a hardness value of 10 mg/L (representative of conditions in Rock Creek) the standards for identified metals are: cadmium - 0.0002 mg/L; copper - 0.0017 mg/L; lead - 0.00017 mg/L; silver - 0.00008 mg/L; zinc - 0.015 mg/L. Note that the 10 mg/L hardness value used in this footnote for calculating aquatic life standards for metals is lower than the minimum hardness value of 25 mg/L that appears in WQB-7. Therefore, calculations of the aquatic life standards using the 10 mg/L value are considered conservative, and protective of aquatic life.

= Clark Fork River Voluntary Nutrient Reduction Program (VNRP) targets for mainstem (Tri-State Council, Draft 9/20/97)

Rock Creek Montana Pollutant Discharge Elimination System (MPDES) permit on protection of beneficial uses and promulgated water quality standards necessary to protect those uses. Designated beneficial uses include potability for public water supply; growth and propagation of salmonid fish and associated aquatic life; wildlife; agriculture; recreation; and industrial supply. A Total Maximum Daily Load (TMDL) calculation would be required because Rock Creek is listed as a water quality-limited stream. The permit effluent limits may serve as a basis for Waste Load Allocation (WLA), a portion of the TMDL process, however, the issuance of a discharge permit does not require that a TMDL be completed.

For ground water, the applicable standards are the primary drinking water standards established by the EPA under the Safe Drinking Water Act or Montana standards, whichever is lower (see **Table 4-9**). In implementing these standards, the DEQ requires analysis of dissolved metals. Ground waters are designated Class I waters and are protected for human consumption, irrigation, livestock, wildlife, and commercial and industrial purposes without treatment (ARM 17.30.1002).

Both surface and ground water in the vicinity of the project are considered high quality waters and are subject to Montana's Nondegradation Policy (75-5-303, MCA). Discharges to high-quality waters are allowed provided that all existing uses of state water are protected and the resultant change in quality is determined to be nonsignificant by the criteria of ARM §17.30.712. In this section, water quality impacts are calculated and compared to existing standards and trigger values, for toxic parameters, which are used to determine if impacts are nonsignificant as per the Nondegradation Rules (ARM §17.30.707(23)). Water quality impacts and comparison to existing standards, and trigger values are used to determine whether or not a given increase in the concentration of parameters is significant or nonsignificant as per the nondegradation rules (ARM §17.30.707 [23]); that is, the maximum allowable increase in concentration.

The Idaho Department of Health and Welfare, Division of Environmental Quality, administers Idaho's Water Quality Standards (see **Table 4-9**). These standards, along with newly adopted numeric toxics criteria based on the National Toxics Rule, effective August 24, 1994, would be used to evaluate ASARCO's proposed discharge to the Clark Fork River and potential impacts to Idaho water resources. For substances that Idaho does not regulate by numeric criteria, the EPA 1986 Quality Criteria for Water (Gold Book) values are used, along with other methods, to determine impacts to designated beneficial uses. Designated beneficial uses of the Clark Fork River and Lake Pend Oreille include domestic and agricultural water supply, cold-water biota, salmonoid spawning, and primary and secondary contact recreation.

Idaho standards also designate the Clark Fork River in Idaho and Lake Pend Oreille as Special Resource Waters. This designation, a part of Idaho's antidegradation policy, requires that existing water quality cannot be lowered. Lowering of water quality is defined as a measurable adverse change in chemical, physical, or biological parameter relevant to a beneficial use. Finally, Section 401 of the Clean Water Act prohibits another state to authorize a discharge which violates a downstream state's water quality standards.

The draft MPDES discharge permit for the proposed project was issued for review in February 1996. The draft permit has been revised in response to agency and public comments. The revised draft permit includes ambient standards for ground water and average monthly discharge limits for treated effluent reporting to surface water resources. These standards and effluent limits are provided in **Table 4-9.** A fact sheet and the statement of basis for the revised draft MPDES permit is reproduced in its entirety as **Appendix M** of this supplemental EIS.

Alternative I

Under Alternative I, impacts to surface and ground water could result from land development activities in the Rock Creek drainage, such as timber harvest and home-building. Sediment-loading to Rock Creek could increase an unknown amount from the present due to road-building and land-clearing from timber harvest.

Watershed modeling completed by the Agencies was used to predict and evaluate the cumulative watershed effects of the existing harvest, roading and proposed mining alternatives within the Rock Creek watershed. The KNF uses the R1-WATSED model. The model predicts the highest 30-day average water yield increase and the annual sediment yield increase using naturally caused and human activities in the watershed as input. Water yield and sediment yield recovery is also predicted by the model. The predicted values generated by the model do not reflect rare or episodic weather events (such as the rain-on-snow events that have occurred in this area in the past), or the effects the predicted increases will have on water quality, fish or aquatic habitat. The volumes predicted for sediment generation reflect increases of suspended sediment only and do not include any in-channel generated sediment. The sediment values predicted are not exact amounts.

The model was run for each proposed alternative action to the year 2031 to review hydrologic and sediment recovery over the life of the mine. Results of the model for Alternative I, or no action, would result in a continuation of the existing conditions and recovery rates within the Rock Creek watershed.

Alternative II

The proposed adits, underground mine, mill facility, utility corridor, waste rock dump, and the tailings impoundment would have the potential to affect surface and ground water resources. Hydrologic effects would include changes in water availability and water quality.

Ground Water Quantity

Evaluation Adit. Most ground water in the vicinity of the evaluation adit probably moves through fractures and faults. Because there are no hydraulic conductivity data for the Copper Lake Fault, the rate of adit water inflow from the fault cannot be estimated. The evaluation adit would not intersect the Copper Lake Fault to reduce the potential risk of encountering unexpected inflows from this fault (ASARCO, Incorporated 1992).

Ground water inflow to the evaluation adit would increase as the adit is extended, and would reach a maximum of about 112 gpm. A safety factor of 1.5 was applied to this estimate to generate a reasonable case inflow of 168 gpm. The actual inflow may be higher or lower depending on the hydrogeologic characteristics encountered. Water requirements for driving the adit would average 30 gpm during the drilling cycle, and some additional water may be needed for dust control in the adit. A small amount of potable water would also be needed for the lavatory and lunchroom in the shop. Therefore, approximately 138 gpm of excess water would be produced during development of the evaluation adit.

Underground Mine. Ground water inflow into mine adits would be about 152 gpm. A safety factor of 1.5 was applied to this estimate to generate a reasonable case inflow of 228 gpm. Actual inflows may be higher or lower depending on local hydrogeologic conditions.

Ground water in the mine area occurs primarily in fractures (joints and faults) in bedrock. Assuming the mine workings were below the water table, ground water would eventually flow into the underground workings. Mine inflows would occur when a saturated fracture or saturated fracture system was encountered by the mine adit or workings. If not grouted, inflow from the fracture would soon decline as ground water stored in the fracture flowed in to the mine workings. Inflow could still continue from the fracture, but at a lesser rate. This rate would be equal to the rate of ground water recharge to the fracture or the same rate as steady state conditions. Inflow into the mine workings would increase as the size of the mine increased, and could reach a maximum of about 1,650 gpm (safety factor equal to 2.0) by the end of production. A larger safety factor was used to reflect a greater degree of uncertainty in the estimated inflow. ASARCO would grout areas where water was flowing into the adits and mine workings. Grouting would be used as the primary mechanism to reduce adit and mine inflows. A summary of combined inflows to the evaluation adit, conveyor and service adits, and underground mine, including safety factors to account for uncertainty in the estimates, are provided in **Table 4-10**. Actual inflows may be higher or lower depending on local hydrogeologic conditions. Variations in flow estimates ultimately would affect the size of waste water treatment systems and the area required for siting waste water treatment facilities, and the rate of ground water withdrawals for make-up water supplies.

TABLE 4-10.
Estimated Ground Water Inflows for Alternative II

Proposed Project Portal Site	Inflow in gpm (no safety factor)	Inflow in gpm (safety factor applied)
Evaluation Adit	112	168
Conveyor and Service Adits	152	228
Ore Body Area	825	1,650
Total Inflow	1,089	2,046

Source: ASARCO, Incorporated 1987-1994.
Note: Safety factors of 1.5 (for the adits) and 2.0 (for the ore body) were used. Flow rates and safety factors are estimated and may differ based on local and site-specific conditions.

Excess Mine Water Storage. By year 30, up to a maximum of 207.7 million gallons of mine water could be stored in a reservoir in the underground mine as a method of managing excess water (see **Figure 2-14**). The maximum volume stored each year would vary. The reservoir would be developed in mined out sections of the ore body. Potential for seepage from the reservoir to ground water exists, but is expected to be relatively low due to the low hydraulic conductivity of the bedrock in the underground mine. Seepage water would likely contain elevated concentrations of nitrate, metals, and total dissolved solids (TDS). Seepage could either be retained in fractures or could migrate and possibly exit to the surface at seeps or springs at undetermined locations in the Rock Creek, Copper Gulch, or East Fork Bull River watersheds. The potential for the development of continuous cracks or conduits that would allow significant quantities of mine water to reach the surface is considered remote.

Tailings Impoundment Seepage. Tailings slurry decant water would probably seep from the base of the tailings impoundment and enter the ground water system during the mine's operational life. The rate of seepage would be proportional to the impoundment area and the depth of water in the impoundment.

The maximum rate of seepage from the proposed tailings impoundment may be several hundred gpm (ASARCO, Incorporated 1987-1994). The Agencies have used a value of 241 gpm in the ground water loading analysis. This seepage rate was estimated based on the results of numerical computer modeling completed by Dames and Moore for ASARCO, and which were subsequently reviewed and incorporated into the Agencies' analyses of impacts.

After reclamation of the tailings impoundment, seepage from the impoundment would decrease dramatically because tailings water would no longer be stored, and surface water runoff from precipitation would be rerouted off the reclaimed impoundment surface to minimize infiltration. Seepage through the tailings dam and the bottom of the impoundment also would decrease as the saturated water levels dropped.

The length of time necessary to completely dewater the tailings impoundment cannot be predicted with accuracy. Dewatering could occur in the impoundment over several decades, and would be limited due to the low permeability of the underlying lacustrine sediments. Therefore, the perimeter seepage collection system could potentially need to be operated and maintained for several decades.

Mine Closure. ASARCO would monitor inflow to underground workings during operations in order to predict whether the adits would discharge mine water following operations, and whether the expected flow would meet applicable water quality standards. If the discharge did not meet MPDES permit requirements, ASARCO proposes to seal the adits near the ore body following the cessation of operations. Adit sealing is a technique used to control and redirect mine water flow; it does not prevent mine water discharge. Water quality of mine discharge is discussed under Surface Water Quality.

If the adits were successfully sealed, the mine water would rise until the outflow along natural pathways equaled the rate of mine water inflow. Ground water elevations may return to their premining levels. Instead of one or two point-source discharges at the mine adits, mine water discharge could be more diffuse, potentially occurring as springs and seeps, discharge to valley fill ground water systems, and/or baseflow in streams if continuous cracks or conduits to the surface are present. If the adit plugs leaked, the rise in mine water levels would be less. However, adit sealing would likely have little effect on the discharge water quality. Adit plugs have an expected life ranging from several decades to centuries. Without periodic inspection and maintenance, the adit plugs may eventually fail. In this event, water under pressure would discharge to the surface, would cause erosion, and would increase flow in West Fork Rock Creek.

Ground Water Quality

Tailings impoundment seepage would be diluted by ground water flow beneath the impoundment, and would be contained in a DEQ-approved ground water mixing zone using a system of perimeter trenches and recovery wells. Seepage impacts to ground water outside the mixing zone would be minor.

Seepage Water Quality. The Agencies expect that the quality of the tailings slurry decant water for the proposed project would be similar to the ASARCO Troy tailings water. ASARCO Troy tailings water characteristics are presented in **Table 4-11** (ASARCO data) and **Table 4-12** (DHES data). Leachate from the proposed Rock Creek tailings impoundment would probably percolate into ground water and change the quality of ground water below the tailings impoundment (see **Table 4-13**). Seepage would recycle back to the tailings impoundment via a perimeter seepage collection system. After mining, the seepage from the impoundment would decrease and the resulting water quality would improve. After mining, concentrations would decrease from these values and approach baseline. The time required for this is unknown.

After mine closure, the tailings impoundment would slowly dewater, thus lowering water levels and exposing any sulfide mineralization in the tailings to oxidation and bacterial action. However, it is expected that the tailings would also have a low sulfide content (Timothy Hayes, U.S. Geological Survey, in a letter to Rebecca Miller, March 6, 1995). In addition, initial testing of the tailings material indicates a net neutralizing potential. Therefore, although uncertainty exists, acid drainage from the tailings is not expected (see Acid Rock Drainage section in **Geology**).

Seepage Collection and Pump Back System. Seepage to ground water from the impoundment would be intercepted by a tailings impoundment seepage collection system consisting of underdrains, seepage collection trenches, and ground water capture wells. Ground water capture wells would be located approximately 200 to 300 feet downgradient of the seepage collection ditches. Capture wells would intercept ground water coming from each of the impoundment sub-basins and would return it to the impoundment (see **Figure 2-13**). This also would potentially decrease static water levels in wells outside of Clark Fork alluvium and springs downgradient of Miller Gulch during mine operation.

Wells would be operated through the mine's operational life and until such time as seepage-contaminated ground water met water quality standards. Nitrate and nitrite, and manganese would exceed ground water quality standards during mine operation and would likely return to pre-mine levels when the impoundment reached equilibrium. (Manganese already exceeds standards in ambient ground water.) The seepage collection system could be designed to eliminate the potential for migration of constituents to Miller Gulch outside the Agency-approved mixing zone, and to Rock Creek and the Clark Fork River. If monitoring indicated bypass of seepage, the pumping rates could be adjusted, or additional wells could be added to increase the efficiency of the pump-back system.

Surface Water Quantity

Evaluation Adit. The proposed evaluation adit area lies adjacent to an unnamed tributary within the headwaters of the West Fork Rock Creek drainage. The unnamed tributary is ephemeral near the proposed adit location and becomes perennial about 0.8 miles below the proposed adit location where two springs provide perennial flows between 20 and 100 gpm. It is not anticipated that the evaluation adit would affect existing spring flow, or tributary flow to Rock Creek.

TABLE 4-11
Troy Tailings Impoundment Water Quality (ASARCO Data)

Parameter	Number of Samples	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	53	7.5	0.3	8.4	6.8
Total Suspended Solids	57	779	1,276	6,541	<1
Total Hardness (as $CaCO_3$)	57	72	35	300	21
Calcium	57	18.6	6	31	5.6
Magnesium	57	5.7	3.3	20	1.6
Sodium	55	20	9	46	1.7
Potassium	59	28.6	17.8	75	0.2
Bicarbonate	53	78.8	29.1	150	21
Sulfate (SO_4)	59	23	10	42	1
Chloride	55	6.0	4.1	24	<1
Ammonia (NH_3 as N)	58	7.2	3.3	14	0.05
Total Kjeldahl Nitrogen (as N)	52	8.1	4.1	20	0.03
Nitrate and Nitrite (as N)	60	15.9	7.0	30	2.3
Orthophosphate (PO_4-P)	53	0.031	0.038	0.23	0.009
Total Phosphorous	53	0.058	0.061	0.3	0.01
Arsenic (DIS)	4	<0005	0.0	<0.005	<0.005
Arsenic (TRC)	1	0.02	0.0	0.02	0.02
Cadmium (DIS)	8	0.002	0.002	<0.005	0.0001
Cadmium (TRC)	57	0.0017	0.0016	0.005	<0.0001
Chromium (DIS)	0	NC	NC	ND	ND
Chromium (TRC)	0	NC	NC	ND	ND
Copper (DIS)	10	0.037	0.034	0.09	0.003
Copper (TRC)	64	0.8	3.4	27	0.007
Iron (DIS)	1	0.050	0.0	0.050	0.050
Iron (TRC)	56	2.3	5.5	38	0.04
Lead (DIS)	10	0.015	0.019	<0.05	0.001
Lead (TRC)	65	0.126	0.327	2.2	<0.001
Manganese (DIS)	5	0.429	0.084	0.55	0.33
Manganese (TRC)	57	1.9	8.4	63	0.02
Mercury (DIS)	4	0.001	0.0	<0.001	<0.001
Mercury (TRC)	1	0.0005	0.0	0.0005	0.0005
Selenium (DIS)	0	NC	NC	ND	ND
Selenium (TRC)	0	NC	NC	ND	ND
Silver (DIS)	8	0.004	0.003	<0.01	<0.0002
Silver (TRC)	59	0.0042	0.0048	0.023	<0.0002
Zinc (DIS)	6	0.019	0.007	0.03	0.01
Zinc (TRC)	62	0.078	0.359	2.8	0.001

Source: ASARCO, Incorporated 1987-1997.
Notes: All units are in mg/L unless otherwise indicated.
SU =Standard pH Units TRC =Total Recoverable Metals Analysis
NC =Not Calculated ND =No Data

For purposes of statistical analyses, detection limit values were used for data reported as below detection.

TABLE 4-12
Troy Tailings Impoundment Water Quality (DHES Data)

Parameter	Number Of Samples	Average	Standard Deviation	Maximum Value	Minimum Value
pH (SU)	1	7.7	NC	7.7	7.7
Total Suspended Solids	0	NC	NC	ND	ND
Total Hardness (as $CaCO_3$)	1	79	NC	79	79
Total Alkalinity (as $CaCO_3$)	1	111	NC	111	111
Sulfate (SO_4)	1	44.9	NC	44.9	44.9
Ammonia (NH_3 as N)	1	13.8	NC	13.8	13.8
Total Kjeldahl Nitrogen (as N)	0	NC	NC	ND	ND
Nitrate and Nitrite (as N)	1	29.8	NC	29.8	29.8
Orthophosphate (PO_4-P)	1	0.015	NC	0.015	0.015
Total Phosphorus	0	NC	NC	ND	ND
Arsenic (DIS)	2	0.004	NC	0.007	<0.001
Arsenic (TRC)	1	0.014	NC	0.014	0.014
Cadmium (DIS)	1	0.001	NC	<0.001	<0.001
Cadmium (TRC)	1	0.001	NC	<0.001	<0.001
Chromium (DIS)	1	0.001	NC	<0.001	<0.001
Chromium (TRC)	1	0.002	NC	0.002	0.002
Copper (DIS)	2	0.026	NC	0.036	0.016
Copper (TRC)	1	1.16	NC	1.16	1.16
Iron (DIS)	2	0.03	NC	0.05	<0.01
Iron (TRC)	1	1.17	NC	1.17	1.17
Lead (DIS)	2	0.0015	NC	0.002	<0.001
Lead (TRC)	1	0.028	NC	0.028	0.028
Manganese (DIS)	2	0.747	NC	1.03	0.464
Manganese (TRC)	1	1.16	NC	1.16	1.16
Mercury (DIS)	0	NC	NC	ND	ND
Mercury (TRC)	0	NC	NC	ND	ND
Selenium (DIS)	0	NC	NC	ND	ND
Selenium (TRC)	0	NC	NC	ND	ND
Silver (DIS)	1	0.001	NC	<0.001	<0.001
Silver (TRC)	1	0.001	NC	<0.001	<0.001
Zinc (DIS)	2	0.0395	NC	0.068	0.011
Zinc (TRC)	1	0.023	NC	0.023	0.023

Source: Department of Health and Environmental Sciences 1995.
Notes: All units are in mg/L unless otherwise indicated.

SU = Standard pH Units
DIS = Dissolved Metals Analysis
NC = Not Calculated
TRC = Total Recoverable Metals Analysis
ND = No Data

For purposes of statistical analyses, detection limit values were used for data reported as below detection.

TABLE 4-13
Estimated Ground Water Quality Resulting from Tailings Impoundment Seepage Below Tailings Impoundment

Parameter	Ambient Groundwater Quality§	Estimated Tailings Seepage Water Quality	Resultant Ground Water Quality for Alternatives II, III, and IV	Resultant Groundwater Quality for Alternative V	Montana Water Quality Standard
pH (SU)	7.8313	7.5[a]	7.6	7.8	N/A
Total Hardness (as $CaCO_3$)	204.6875	72[a]	119	180	N/A
Total Alkalinity (as $CaCO_3$)	215.3333	111[b]	148	196	N/A
Sulfate (SO_4)	7.7583	23[a]	17.6	10.6	N/A
Ammonia (NH_3 as N)	<0.01*	7.2[a]	4.7	1.3	N/A
Total Kjeldahl Nitrogen (as N)	<0.01*	8.1[a]	5.2	1.5	N/A
Nitrate and Nitrite (as N)	0.2994	15.9[a]	10.4	3.2	10
Orthophosphate (PO_4-P)	0.0591	0.031[a]	0.04	0.05	N/A
Total Phosphorus	1.4885	0.058[a]	0.56	1.22	N/A
Arsenic (DIS)	0.0020	0.004[b]	0.0033	0.0024	0.018
Cadmium (DIS)	0.0009	0.002[a]	0.0016	0.0011	0.005
Chromium (DIS)	0.0170	<0.001[b]	0.0063	0.0139	0.1
Copper (DIS)	0.0013	0.037[a]	0.0244	0.0080	1.0
Iron (DIS)	0.0623	0.05[a]	0.0543	0.0600	0.3
Lead (DIS)	0.0015	0.015[a]	0.0102	0.0040	0.015
Manganese (DIS)	0.2895	0.747[b]	0.5859	0.3749	0.05
Mercury (DIS)	0.0004**	0.001[a]	0.0004**	0.0004**	0.00014
Selenium (DIS)	0.0028	ND	NC	NC	0.05
Silver (DIS)	0.0002	0.004[a]	0.0014	0.0005	0.05
Zinc (DIS)	0.0329	0.0019[a]	0.0485	0.0303	5.0

Source: (a) = ASARCO, Incorporated 1987-1997 (see Table 4-11)
(b) = Department of Health and Environmental Sciences 1995 (see Table 4-12)

Notes: All units are in mg/L unless otherwise indicated.

SU = Standard pH Units
DIS = Dissolved
¶ = pH and Temperature Dependent
ND = No Data
N/A = Not Applicable

Shading = Exceeds Standard (see Table 4-9)
§ = Uses "Average" from Table 3-8, except at noted.
* = Uses "Minimum Value" from Table 3-8 per request by EPA.
NC = Not Calculated

** Twelve samples were collected. All samples were below the laboratory detection limit value. Therefore, the conclusion that ambient ground water quality exceeds Montana water quality standards cannot be made.

Wilderness Lakes. Of the several lakes located above or adjacent to the underground mine area in the Rock Creek and Copper Gulch watersheds, only Cliff and Copper lakes lie above the ore body. Moran Basin Lake lies below and north of the ore body. Major faults such as the Copper Lake Fault, and potential fracturing resulting from mining might possibly act as conduits for flow out of the lakes. St. Paul and Rock lakes are located on the northeast side of the Rock Lake Fault and thus are structurally separated from fractures that might result from mining. For example, faults and fractures might provide a hydraulic connection between mine workings and the overlying surface or with ground water if ASARCO's pilot hole testing and grouting programs were ineffective. Fractures would need to be continuously interconnected for impacts to occur. Therefore, the potential for impacting water levels in wilderness lakes is considered remote (see **Geology**).

To further minimize the potential for impacts to surface water resources in the wilderness, ASARCO would also maintain an adequate pillar size and spacing that would be based on rock mechanics data collected during construction of the evaluation adit. In addition, ASARCO would maintain a barrier pillar, (if necessary) near the Copper Lake Fault to isolate the mine workings from any potential water stored in the fault, and thus minimizing the possibility of lowering lake water levels.

Mill Facility and Make-up Water Requirements. The proposed mill facility would require up to 3,760 gpm of water during the project's operational phase. Mill make-up water would first come from excess water in the mine or from the tailings impoundment, if available. A well located in alluvial gravels adjacent to the Clark Fork River would supply the required additional make-up water.

Actual make-up water requirements from a production well would depend on the uncertain availability of mine water. The flow in the Clark Fork River could be reduced by an amount equal to the pumping rate of ASARCO's production well. Under extreme worst case conditions, make-up water requirements would potentially decrease flows in the Clark Fork River by about 549 gpm. This level of flow reduction would only be expected if the underground mine did not intercept any ground water, and all make-up water came from the ASARCO production well. The demand for make-up water from a well would most likely be the highest during the early phases of the project (when the size of the underground mine is too small to produce the required volume of water), or in abnormally dry climatic periods. Assuming flows in the Clark Fork River are reduced, slightly less hydroelectric power could be generated at Cabinet Gorge. The monetary impact of this loss is insignificant, and could likely be offset by the purchase of electrical power for the proposed project.

Drainage and Surface Water. Construction of the proposed tailings impoundment would alter the topography and drainage characteristics of about 324 acres in Miller Gulch. During the proposed project life, about 5 miles of ephemeral tributaries to Miller Gulch would be covered by fill material and tailings, and would essentially be removed from the natural hydrologic system. Therefore, surface water runoff to Miller Gulch would be expected to decrease temporarily during the proposed mine life. In addition, one spring and several existing ground water monitoring wells would be covered by tailings material. Runoff from the reclaimed impoundment surface would be routed to a diversion ditch and transferred to the Rock Creek drainage and Miller Gulch. Flows into West Fork Rock Creek near the proposed mill site would be rerouted in culverts, and likely would impact existing Waters of the U.S. (see Waters of the U.S. and Wetlands).

Surface flow from Miller Gulch is currently appropriated for power generation, irrigation, and domestic uses (Water rights P029428, W131977, and W131978). ASARCO does not have water rights to appropriate surface water in Miller Gulch. The disruption of natural surface water runoff to Miller Gulch

during the proposed mine life could, at times, reduce flows for existing beneficial uses of surface water. These impacts, however, cannot be quantified. ASARCO would be required, under the Metal Mine Reclamation Act (82-4-355 MCA), to repair or replace any existing use of surface or ground water that was affected by the proposed project.

Surface Water Quality

Adit and Mine Water. Drilling and blasting activities would contribute to high concentrations of suspended solids in the adit water and mine effluent. Suspended solids contribute nearly all of the total metals load to mine effluent and must be removed. Initial removal of suspended solids can be accomplished using settling sumps, with or without chemical flocculating agents and subsequent filtration. Although this treatment scheme would significantly improve water quality, some dissolved metals and most of the nitrogen compounds would remain in the water.

Underground mining is expected to influence mine discharge water quality mainly as a result of blasting activities. As much as 1 to 6 percent of the nitrogen in the explosives would be expected to remain in water discharged from the mine (British Columbia Ministry of the Environment 1983). In general, the nitrogen discharged from the mine would be mainly nitrate, with relatively small amounts of more toxic ammonia and nitrite (British Columbia Ministry of the Environment 1983).

During the latter stages of mining, the mine may at times discharge about 1,700 gpm of water as a result of seepage from ground water into the mine workings. Discharge from the mine would be expected during the operational and postoperational periods of mining. Due to similarities in the geology of the ore bodies, mining methods, and type of explosives, it is assumed that mine adit water quality for the proposed project would be similar to mine adit water quality for the ASARCO Troy Mine.

The analysis of data indicates untreated mine water would contain elevated levels of TSS, nitrate, and total metals.

The potential for acid mine drainage to develop is not anticipated based on available geochemical testing data (see **Geology**). In addition, postoperational mine water quality data for the geochemically similar ASARCO Troy Mine suggest that concentrations of constituents in adit discharges decrease with time. The decrease is likely the result of the termination of mining, sediment production, and use of explosives. Mine adit discharge water treatment would be expected until such time that standards can be met without treatment. However, there are no legal water quality standards that would have to be met before the adits could be plugged and sealed. Nevertheless, the Agencies would need to review and approve the adit closure plan prior to adit closure.

Regardless of actual flow rates or concentrations of constituents in the discharges associated with the proposed project, ASARCO would have to meet all load limitations specified in the MPDES permit issued by DEQ.

Waste Rock. Waste rock would be produced as a result of driving the evaluation adit and two access adits in predominantly nonmineralized rock in order to gain access to the ore body. Waste rock would be used in the construction of the mill pad, and would be stored on a hillside waste rock dump. Waste rock from the mineralized zone would be stored in underground workings.

Waste rock potentially containing residual nitrogen compounds from blasting and some fine grained material would be used in the construction of the proposed mill pad, and would potentially increase the load of nitrogen, TSS, and other non-toxic constituents in Rock Creek during the period of construction. Based on whole rock analysis any sediment entering Rock Creek should not contain elevated concentrations of heavy metals. Resultant water quality impacts on Rock Creek cannot be estimated with certainty, and would depend on the explosive misfires or incomplete reactions, the relative use of slurry gels rather than ANFO, particle size distribution of the waste rock and the actual waste rock nitrogen content, rainfall and temperature conditions, infiltration capacity of the mill pad, potential for surface ponding, and actual streamflow during the period of construction. Research suggests that the impacts of leaching soluble nitrogen in waste rock would be short lived. Most nitrogen compounds could be leached out within 1 month to 1 year (British Columbia Ministry of the Environment 1983); the remainder would leach out within 5 years.

Milling Process. Reagents proposed by ASARCO range from non-toxic to toxic to humans and fish (see **Appendix F** and **Aquatics/Fisheries**).

Water Treatment. A passive biotreatment system would be used to treat mine water. An ion exchange system also would be installed as a final polishing step to ensure the quality of water discharged to the Clark Fork River. There were numerous public comments questioning the effectiveness and reliability of the proposed nitrate removal treatment stage of the mine waste water treatment system. While the proposed passive biotreatment cells have been used on a limited basis to treat mine waste water, the capability of passive biotreatment cells to treat mine waste similar to that anticipated at Rock Creek and under climatic conditions similar to that anticipated at Rock Creek has not been adequately delineated. The proposed passive biotreatment system has not been proven to be capable of providing the degree of nitrogen removal required to meet the limits in the draft MPDES discharge permit released for review in February 1996.

The public also express concerns as to the complexity of the proposed ion exchange nitrate removal system and the quality, quantity and final disposal of the concentrated waste stream generated by the ion exchange system. Because ion exchange resins are either cation or anion specific, a two step process would be required to remove both ammonia and nitrate-nitrogen. This increases the cost and complexity of the treatment process. Ion exchange systems have not been used extensively for nitrate removal from mine waste water. Therefore, the long term reliability of ion exchange as a nitrate removal system has not been demonstrated.

Although there is some doubt about the proposed waste water treatment systems ability to achieve sufficient levels of nitrate removal under Alternative II, the analysis that follows assumes that systems would be designed or modified such that they would remove dissolved solids, heavy metals, ammonia and nitrate/nitrite to comply with MPDES discharge requirements. **Table 4-14** provides ASARCO's estimate of untreated and treated water quality for the proposed project (ASARCO, Incorporated 1997) as well as discharge limits set in the revised draft MPDES permit. The maximum concentrations of the treated effluent are carried forward into **Tables 4-15, 4-16, and 4-17** to estimate the reasonable worst case impacts to surface water quality.

The actual effects on Clark Fork River water quality due to discharge of adit water from the proposed project would vary both seasonally and annually for the proposed 30-year mine operational

TABLE 4-14
Estimated Untreated and Treated Discharge Water Quality

Parameter	Effluent Prior to Treatment		Treated Effluent	
	Average Concentration[1]	Maximum Concentration	Average Concentration	Maximum Concentration
pH (SU)	7.49	8.4	7.5	8.4
Total Suspended Solids	779	6,541	10	30
Total Hardness (as $CaCO_3$)	72	300	72	300
Total Alkalinity (as $CaCO_3$)	ND	ND	ND	ND
Sulfate SO_4	22.6	42	22.6	42
Ammonia (NH_3 as N)	7.2	14	1.43	2.8
Total Kjeldahl Nitrogen (as N)	8.1	20.0	1.6	4.0
Nitrate and Nitrite (as N)	15.9	30.0	3.18	6.0
TIN	24.4	124.0	4.9	8.8
Orthophosphate (PO_4-P)	0.031	0.23	0.1	0.1
Total Phosphorus	0.058	0.3	0.06	0.23
Arsenic (DIS)	<0.005	<0.005	<0.005	<0.005
Arsenic (TOT)	0.02	0.02	<0.005	<0.005
Cadmium (DIS)	0.002	<0.005	<0.001	<0.005
Cadmium (TRC)	0.0017	0.005	<0.001	<0.001
Chromium (DIS)	ND	ND	ND	ND
Chromium (TRC)	ND	ND	ND	ND
Copper (DIS)	0.037	0.09	0.037	0.09
Copper (TRC)	0.846	27	0.047	0.213
Iron (DIS)	0.05	0.05	0.05	0.05
Iron (TRC)	2.34	38.0	0.079	0.224
Lead (DIS)	0.015	<0.05	<0.01	<0.05
Lead (TRC)	0.126	2.2	<0.017	0.06
Manganese (DIS)	0.43	0.55	0.43	0.55
Manganese (TRC)	1.95	63.0	0.448	0.84
Mercury (DIS)	<0.001	<0.001	<0.001	<0.001
Mercury (TOT)	<0.0005	<0.0005	<0.0005	<0.0005
Selenium (DIS)	ND	ND	ND	ND
Selenium (TRC)	ND	ND	ND	ND
Silver (DIS)	<0.004	<0.01	<0.004	<0.01
Silver (TRC)	0.004	0.023	<0.005	<0.005
Zinc (DIS)	0.019	0.03	0.019	0.03
Zinc (TRC)	0.078	2.80	0.019	0.043

Source: ASARCO, Incorporated 1987-1997.
Notes: [1]All units are in mg/L unless otherwise indicated.

SU	= Standard pH Units	TRC	= Total Recoverable Metals Analysis
DIS	= Dissolved Metals Analysis	ND	= No Data
TOT	= Total Metals Analysis	TIN	= Total Inorganic Nitrogen

TABLE 4-15
Estimated Water Quality in the Clark Fork River at Average Flow (21,462 cfs) Resulting From Proposed Discharge

Parameter	Ambient Clark Fork Water Quality	Estimated Water Quality of Proposed Discharge	Calculated Load (lbs/day)	Resultant River Water Quality	Revised Draft MPDES Permit Average Monthly Limit (lbs/day)	Montana Water Quality Standard & Trigger Value
pH (SU)	8.09[b]	8.4[a]	232	8.09007394	N/A	6.5-8.5
Total Suspended Solids	2.5[b]	30[a]	829	2.50655887	552.0	N/A
Total Hardness (as $CaCO_3$)	85.7[b]	300[a]	8290	85.7511115	N/A	N/A
Total Alkalinity (as $CaCO_3$)	80.7[b,c]	ND[a]	NC	NC	N/A	N/A
Sulfate (SO_4)	2.1667[a]	42[a]	1161	2.17620041	N/A	N/A
Ammonia (NH_3 as N)	0.0056[b]	2.8[a]	77	0.00626648	N/A	1.3*; 0.01[t,&]
Total Kjeldahl Nitrogen (as N)	0.1419[b]	4.0[a]	111	0.14282017	N/A	N/A
Nitrate and Nitrite (as N)	0.0273[b]	6.0[a]	166	0.02872451	N/A	10; 0.01[t]
TIN	0.0329[b]	8.8	243	0.03499099	193.4	N/A
Orthophosphate (PO_4-P)	0.003[b]	0.23[a]	2.76	0.00302313	N/A	N/A
Total Phosphorus	0.011[b]	0.23[a]	6.36	0.01105223	N/A	N/A; 0.001[t]
Arsenic	0.0003[b]	<0.005[a]	0.14	0.00030112	0.0075	0.018
Cadmium	0.000642[b]	<0.001[a]	0.03	0.00064209	0.994	0.001; 0.0001[t]
Chromium	0.005[a]	ND[a]	0.00	NC	N/A	0.011; 0.005[t]
Copper	0.0003[b]	0.105[a]	2.90	0.00032497	0.414	0.011; 0.0005[t]
Iron	0.04[a]	0.17[a]	4.70	0.04003101	N/A	0.3
Lead	0.0002[b]	0.01[a]	0.28	0.00020234	0.994	0.003; 0.0001[t]
Manganese	0.0100[a]	0.84[a]	23.21	0.01019796	69.0	0.05
Mercury	0.00025[a]	<0.001[a]	0.03	0.00025018**	0.0014	0.000012
Selenium	0.0025[a]	ND[a]	0.00	NC	N/A	0.005; 0.0006[t]
Silver	0.0002	<0.005[a]	0.14	0.00020114	20.7	0.003; 0.0002[t]
Zinc	0.0031[b]	0.033[a]	0.91	0.00310713	N/A	0.095; 0.005[t]

Source: (a) = ASARCO, Incorporated 1987-1997 (see Table 3-5). (b) = Department of Health and Environmental Sciences 1994 (see Table 3-4).

Notes: All units are in mg/L unless otherwise indicated. Calculations assume discharge rate equals 2,300 gpm (5.12 cfs).

SU = Standard pH Units
TIN = Total Inorganic Nitrogen
& = pH and Temperature Dependent
ND = No Data
NC = Not Calculated
t = Trigger Value
N = Narrative Standard
N/A = Not Applicable
c = As Alkalinity Increases, the Toxicity of Some Metals Decreases
* = Tom Reid, DHES, personal communication, June 18, 1995.
** = The conclusion that the resultant concentrations exceed ambient cannot be made because the water quality criterium is lower than the detection limit.
= See "Maximum Concentration" listed in Table 4-14. Detection limit value used if maximum concentration was listed as less than detection.

Shading = Exceeds water quality standard or trigger value

TABLE 4-16

Estimated Water Quality in the Clark Fork River at $Q_{7,10}$ Flow (3,610 cfs) Resulting from Proposed Discharge

Parameter	Ambient Clark Fork Water Quality	Estimated Water Quality of Proposed Discharge	Calculated Load (lbs/day)	Resultant River Water Quality	Revised Draft MPDES Permit Average Monthly Limit (lbs/day)	Montana Water Quality Standard & Trigger Value
pH (SU)	8.09[b]	8.4[a]	232	8.09043904	N/A	6.5-8.5
Total Suspended Solids	2.5[b]	30[a]	829	2.53894753	552.0	N/A
Total Hardness (as $CaCO_3$)	85.7[b]	300[a]	8290	86.0035075	N/A	N/A
Total Alkalinity (as $CaCO_3$)	80.7[b,c]	ND[a]	NC	NC	N/A	N/A
Sulfate (SO_4)	2.1667[a]	42[a]	1161	2.22311486	N/A	N/A
Ammonia (NH_3 as N)	0.0056[b]	2.8[a]	77	0.00955764	N/A	1.3*; 0.01[t,&]
Total Kjeldahl Nitrogen (as N)	0.1419[b]	4.0[a]	111	0.14736413	N/A	N/A
Nitrate and Nitrite (as N)	0.0273[b]	6.0[a]	166	0.03575898	N/A	10; 0.01[t]
TIN	0.0329[b]	8.8	243	0.04531661	193.4	N/A
Orthophosphate (PO_4-P)	0.003[b]	0.23[a]	2.76	0.00313738	N/A	N/A
Total Phosphorus	0.011[b]	0.23[a]	6.36	0.01131016	N/A	0.02; 0.001[t]
Arsenic	0.0003[b]	<0.005[a]	0.14	0.00030666	0.0075	0.018
Cadmium	0.000642[b]	<0.001[a]	0.03	0.00064251	0.994	0.001; 0.0001[t]
Chromium	0.005[a]	ND[a]	0.00	NC	N/A	0.011; 0.005[t]
Copper	0.0003[b]	0.105[a]	2.90	0.00044828	0.414	0.011; 0.0005[t]
Iron	0.04[a]	0.17[a]	4.70	0.04018412	N/A	0.3
Lead	0.0002[b]	0.01[a]	0.28	0.00021388	0.994	0.003; 0.0001[t]
Manganese	0.0100[a]	0.84[a]	23.21	0.01117551	69.0	0.05
Mercury	0.00025[a]	<0.001[a]	0.03	0.00025106**	0.0014	0.000012
Selenium	0.0025[a]	ND[a]	0.00	NC	N/A	0.005; 0.0006[t]
Silver	0.0002	<0.005[a]	0.14	0.0002068	20.7	0.003; 0.0002[t]
Zinc	0.0031[b]	0.033[a]	0.91	0.00314235	N/A	0.095; 0.005[t]

Source: (a) = ASARCO, Incorporated 1987-1997 (see Table 3-5). (b) = Department of Health and Environmental Sciences 1994 (see Table 3-4).

Notes: All units are in mg/L unless otherwise indicated. Calculations assume discharge rate equals 2,300 gpm (5.12 cfs).

SU = Standard pH Units
TIN = Total Inorganic Nitrogen
& = pH and Temperature Dependent
ND = No Data
NC = Not Calculated
t = Trigger Value
N = Narrative Standard
N/A = Not Applicable
c = As Alkalinity Increases, the Toxicity of Some Metals Decreases
* = Tom Reid, DHES, personal communication, June 18, 1995.
** = The conclusion that the resultant concentrations exceed ambient cannot be made because the water quality criterium is lower than the detection limit.
= See "Maximum Concentration" listed in Table 4-14. Detection limit value used if maximum concentration was listed as less than detection

Shading = Exceeds water quality standard or trigger value

TABLE 4-17

Estimated Water Quality in the Clark Fork River at Lowest Flow (144 cfs) Resulting From Proposed Discharge

Parameter	Ambient Clark Fork Water Quality	Estimated Water Quality of Proposed Discharge	Calculated Load (lbs/day)	Resultant River Water Quality	Revised Draft MPDES Permit Average Monthly Limit (lbs/day)	Montana Water Quality Standard & Trigger Value
pH (SU)	8.09[b]	8.4[a]	232	8.10064378	N/A	6.5-8.5
Total Suspended Solids	2.5[b]	30[a]	829	3.44420601	552.0	N/A
Total Hardness (as $CaCO_3$)	85.7[b]	300[a]	8290	93.0579399	N/A	N/A
Total Alkalinity (as $CaCO_3$)	80.7[b,c]	ND[a]	NC	NC	N/A	N/A
Sulfate (SO_4)	2.1667[a]	42[a]	1161	3.53436696	N/A	N/A
Ammonia (NH_3 as N)	0.0056[b]	2.8[a]	77	0.10154506[+]	N/A	1.3*; 0.01[t,&]
Total Kjeldahl Nitrogen (as N)	0.1419[b]	4.0[a]	111	0.27436695	N/A	N/A
Nitrate and Nitrite (as N)	0.0273[b]	6.0[a]	166	0.23237124	N/A	10; 0.01[t]
TIN	0.0329[b]	8.8	243	0.33391631	193.4	N/A
Orthophosphate (PO_4-P)	0.003[b]	0.23[a]	2.76	0.00633047	N/A	N/A
Total Phosphorus	0.011[b]	0.23[a]	6.36	0.01851931[+]	N/A	N/A; 0.001[t]
Arsenic	0.0003[b]	<0.005[a]	0.14	0.00046137	0.0075	0.018
Cadmium	0.000642[b]	<0.001[a]	0.03	0.00065429	0.994	0.001; 0.0001[t]
Chromium	0.005[a]	ND[a]	0.00	NC	N/A	0.011; 0.005[t]
Copper	0.0003[b]	0.105[a]	2.90	0.00389485[+]	0.414	0.011; 0.0005[t]
Iron	0.04[a]	0.17[a]	4.70	0.04446352	N/A	0.3
Lead	0.0002[b]	0.01[a]	0.28	0.00053648	0.994	0.003; 0.0001[t]
Manganese	0.0100[a]	0.84[a]	23.21	0.03849785	69.0	0.05
Mercury	0.00025[a]	<0.001[a]	0.03	0.00027575**	0.0014	0.000012
Selenium	0.0025[a]	ND[a]	0.00	NC	N/A	0.005; 0.0006[t]
Silver	0.0002	<0.005[a]	0.14	0.00036481	20.7	0.003; 0.0002[t]
Zinc	0.0031[b]	0.033[a]	0.91	0.00412661	N/A	0.095; 0.005[t]

Source: (a) = ASARCO, Incorporated 1987-1997 (see Table 3-5). (b) = Department of Health and Environmental Sciences 1994 (see Table 3-4).

Notes: All units are in mg/L unless otherwise indicated. Calculations assume discharge rate equals 2,300 gpm (5.12 cfs).

SU = Standard pH Units TIN = Total Inorganic Nitrogen

& = pH and Temperature Dependent ND = No Data

NC = Not Calculated t = Trigger Value

N = Narrative Standard N/A = Not Applicable

c = As Alkalinity Increases, the Toxicity of Some Metals Decreases + = Meets water quality standards but exceeds trigger value.

* = Tom Reid, DHES, personal communication, June 18, 1995.

** = The conclusion that the resultant concentrations exceed ambient cannot be made because the water quality criteria is lower than the detection limit.

= See "Maximum Concentration" listed in Table 4-14. Detection limit value used if maximum concentration was listed as less than detection

Shading = Exceeds water quality standard or trigger value

period. The actual water quality impacts would be a function of the volume of water discharged from the mine, the flow rate in the Clark Fork River, and the concentration of chemical constituents in both (see **Tables 4-15, 4-16, and 4-17**). Treated discharge would be piped to the Clark Fork River with a proposed outfall and underwater diffuser downstream of Noxon Reservoir. **Tables 4-15** and **4-16** indicate that water quality standards are met during average flow (21,462 cfs) and low flow ($Q_{7,10}$ equal to 3,610 cfs) conditions in the Clark Fork River. **Table 4-17** suggests that for night-time operations of Noxon Dam (assumed flow of 144 cfs), ASARCO's maximum proposed discharge (2,300 gpm) at the highest predicted concentrations (**Table 4-14**) meet Montana water quality standards, but could possibly result in ammonia, phosphorus, and copper exceeding the trigger values for non-degradation near the point of discharge, and prior to dilution and mixing effects in Cabinet Gorge reservoir reducing the overall impact. The trigger values, however, apply to a nondegradation determination for flows equal to or greater than the $Q_{7,10}$, rather than short-duration flows from the dam that are less than the $Q_{7,10}$. Therefore, trigger value exceedances occurring during these night-time periods are not relevant to the nondegradation determination.

Following operations, mine water would no longer be pumped from the underground workings, and the mine workings would fill with water until the rate of inflow equaled the rate of outflow. Assuming inflows of 1,700 gpm and no outflows, the mine would take about 7 years to fill. Outflow could occur along continuous fractures, or if water levels rose sufficiently, from the mine adits, if adits were not permanently sealed.

After closure of the mine, it could continue to be a ground water conduit, and would likely continue to discharge to surface water. After treatment to meet MPDES discharge limitations, ASARCO proposes to discharge all excess mine water to the Clark Fork River. The mine water quality would improve once mining activities were terminated. In particular, nitrate concentrations are projected to decline rapidly.

Accidental Spills and Ruptures. Significant ruptures or breaks in either the proposed tailings slurry or return water lines could result in short-term water quality degradation of Rock Creek. In the event that pipeline leakage occurred, the system would be shut down and immediately repaired. Pin hole leaks in pipelines, while requiring maintenance or repair, would not likely result in measurable impacts to surface water resources. Impacts due to major ruptures would depend on the location of the rupture and the response time for cleanup.

The accidental rupture of a supply or tanker truck along the proposed utility corridor road could affect water resources in the Rock Creek drainage. An accidental spill from a supply or tanker truck is considered to be an unlikely event. In the event of an accidental spill, ASARCO would implement a spill contingency plan (ASARCO Incorporated 1987-1994; Hydrometrics, Inc. 1997).

Impacts to surface water from unlikely accidental spills or ruptures under Alternative II could be potentially significant (see also **Aquatic/Fisheries**).

ASARCO's mine permit application is not clear as to the fate of mine adit water. The adits could be plugged or the mine could perpetually discharge adit water (meeting MPDES permit requirements) to the Clark Fork River. It is assumed that potential perpetual discharge would be via pipeline. Unless the pipeline

was perpetually maintained, eventual pipeline rupture would be probable, which would result in discharge of the water into Rock Creek near the point of rupture. Because of the lower hardness and less dilution capacity of Rock Creek, such a discharge may result in exceedence of standards in Rock Creek even though the same water would not violate standards in the Clark Fork River. It would be more likely that the adits would be plugged thus avoiding perpetual maintenance of the discharge pipeline.

Sedimentation. Construction activities or mass failure of cuts, fills, embankments and soil stockpiles may temporarily increase sediment loading to Rock Creek and the Clark Fork River. Any increased sedimentation would be of short duration. See **Aquatics/Fisheries** for discussion on impacts from sedimentation to aquatic life.

Sediment yield was estimated by the Agencies using the R1-WATSED model. Actual sediment loading to Rock Creek would depend on weather conditions at the time of construction and the efficiency of best management practices (BMPs) used to control erosion. R1-WATSED modeling results for Alternative II actions showed a one percent increase in peak flows and a 72 percent increase in annual sediment yield during construction and operation of the mine. At the end of the life of mine, the peak flow value would drop back to the existing value and the annual sediment increase is predicted to drop by seven percent. Because this would result in a small overall increase within the watershed. It is expected that conditions would continue to remain the same or worsen with the implementation of this alternative. Potential increases in sediment loading to the Clark Fork River below Noxon Dam would be negligible because of the additional volume of flow available for dilution.

Tailings Impoundment Failure. Catastrophic failure of the tailings impoundment is considered a low-probability event (see **Geotechnical Engineering**). Should such a failure occur, sediment and tailings leachate would be uncontrollably released to the environment.

Under the worst case scenario, tailing liquids containing dissolved metals and reagent residues, and large masses of sediment would flush into stream channels associated with Rock Creek and the Clark Fork River. Portions of this sediment mass would probably remain in these stream channels for an undefined period of time following failure, while the liquid and remaining solids would be carried downstream. (See Johns and Moore 1985, Workman 1985, Moore, Luoma, and Peters 1991, and Wright and Solero 1973 for discussion of heavy metals movement through natural and human-made impoundments). Subsequent to any such failure, seasonal high flows would continue to wash most of the remaining sediment downstream, and this sediment would be deposited in Cabinet Gorge Reservoir upstream of the dam. Sediment and soluble metals and nutrients also would migrate downstream into Lake Pend Oreille. Most of the fine sediments from any such catastrophic failure would probably not persist in the Rock Creek system for many years. Suspended sediment also would move downstream and settle out in Lake Pend Oreille.

Impacts to Rock Creek and the Clark Fork River to Lake Pend Oreille from a tailings impound-ment failure under Alternative II would be significant in the short term and potentially significant in the long term.

Lake Pend Oreille and Idaho's Clark Fork River. Nutrients would undergo biological uptake and processing in approximately 18.5 miles of the Clark Fork River between the discharge near Noxon and the

state line. Because Lake Pend Oreille and the Clark Fork River are designated as Special Resource Waters, the concentration of pollutants from the Rock Creek mine must be below detection limits at the state border (see **Appendix M**). If this is not achievable, the Idaho Division of Environmental Quality (IDEQ) must approve the lowering of water quality or petition to the U.S. Environmental Protection Agency to deny the discharge permit. The approval process must include intergovernmental coordination and public participation, and must evaluate the discharge to see if it is necessary to provide important economic or social development in the area in which the waters (to be polluted) are located. Due to negligible economic or social benefits to Bonner County, IDEQ would have difficulty justifying a lowering of Montana effluent limits for the Rock Creek mine.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

The proposed adits, underground mine, mill facility utility corridor, waste rock dump, and tailings paste facility would have the potential to impact surface and ground water resources under the Alternative V action. However, the degree of impact is reduced compared to Alternatives II, III, and IV. Impacts to water availability and water quality are summarized below.

Although the amount of seepage is greatly reduced under Alternative V, the resultant impacts to ground water remain essentially the same. Alternative V includes measures to mitigate impacts and increase monitoring. In some cases, there was no residual impact to mitigate, but mitigation or additional monitoring has been proposed to address uncertainties in the hydrologic or hydrogeologic analyses. The intent of mitigation is to either reduce risk associated with the possibility of a potential impact or collect additional data during operation to verify the analyses and conclusions presented in the EIS process. A complete listing of the proposed additional mitigation and monitoring plans are presented in the Alternative V description in **Chapter 2** (also see **Appendix H**).

Ground Water Quantity

Evaluation Adit, Underground Mine, and Excess Mine Water Storage. Evaluation activities would remain the same as described for Alternative II in the draft EIS. Water use and supply for the evaluation and underground mining operations would remain the same as described for Alternatives II through IV in the draft EIS. To address issues related to seepage of water from the underground mine, the final water resources monitoring program will be designed to detect changes in the distribution of flow. Mitigations such as additional grouting or handling of underground water could be applied. The Contingency/Corrective Action Plan would identify measures to be taken should monitoring identify potential water resources issues.

Paste Facility Seepage. A tailing impoundment is not proposed under the Alternative V action. This proposed action involves dewatering the tailings, adding water to create a paste of a known consistency along with a binder, if necessary, and placing the resulting paste on the ground surface. The volume of seepage from the paste would be significantly less than with alternatives involving deposition of the tailings as a slurry, since most of the excess water would be removed with paste placement. ASARCO is preparing an underdrain design that would be included as part of the final paste design to collect drainage from the base of the paste facility. The proposed seepage collection system would assist in maintaining a minimal seepage rate to the existing ground water system. Proposed seepage collection is discussed below. Under the paste facility alternative, seepage lost to groundwater is not expected to exceed 20-30 gallons per minute (gpm). The new estimated seepage rate is an order of magnitude less than proposed under Alternatives II through IV. The 20 gpm seepage rate was calculated by ASARCO. An independent estimate of the seepage rate was made by the Agencies' consultant (Klohn-Crippen). Their estimate of 30 gpm corroborates ASARCO's estimate. The 30 gpm seepage rate was used in the analysis of impacts.

Mine Closure. Reclamation of the evaluation disturbances, mill site, and utility corridors would remain the same as described for Alternative IV in the draft EIS. The Agencies would need to review and approve the mine closure plan before the mine adits were plugged. Mine adit discharge would continue to be treated until it could meet MPDES effluent limits without treatment prior to plugging. The mine adits would be plugged near the ore body which would reduce the potential hydraulic head (water pressure) on the adit plug and decrease the risk of the adit plug blowing out. If continuous fractures from the mine to the surface are present under sufficient hydraulic head mine water could seep outward through bedrock creating or impacting springs and seeps. The location and amount of impact on these features cannot be reliably predicted. Springs and small streams surrounding the ore body in the Rock Creek, Copper Gulch, and Bull River watersheds would be monitored, and if levels of impact warrant, measures could be taken (such as grouting or prevention of water accumulation in the mine) to reduce the impact.

Installation of the paste facility underdrain system would result in a reduction of potential infiltration through the base of the paste facility to groundwater. The collection system would continue to operate in conjunction with the waste water treatment facility until the seepage met Montana water quality standards. After mining ceases, water may either (1) seep into the local groundwater system from the collection pond, or (2) be treated and routed to the Clark Fork River. Seepage water not entering the underdrain system would not exceed a maximum of 20-30 gpm and would decrease with time after mining ceases. All discharges would need to comply with the requirements of the MPDES permit.

Ground Water Quality

The quality of the paste seepage water would be similar to the quality of seepage predicted under alternatives II through IV.

Seepage Water Quality. Paste facility seepage would be diluted by ground water flow beneath the impoundment in a DEQ approved mixing zone. A seepage collection system, and downgradient monitoring wells would be used to monitor the quantity and quality of seepage from the paste facility area. In addition, a potential ground water recovery well system similar to that proposed for alternatives II through IV would be installed if monitoring showed a violation of the MPDES permit limits and other measures were ineffective in resolving the situation. Impacts to ground water based on a seepage rate of 30 gpm (for Alternative V) were calculated by the agencies and compared to ground water seepage impacts for Alternatives II, III, and IV (**Table 4-13**). Data provided in **Table 4-13** indicate that some constituents (for example, nitrate) in tailings seepage water are of poorer quality (higher concentration) than ambient ground water concentrations. In these cases, constituents contained in tailings seepage degrade water quality in the ground water mixing zone. In other cases, some constituents in tailings seepage (for example, phosphorus) are lower than ambient ground water concentrations. In these cases, adding tailings seepage to the aquifer has a diluting effect, and ground water quality for these constituents actually improves over baseline conditions. The degree to which resultant ground water quality either degrades or improves is directly proportional to the rate of seepage.

Data provided in Table 4-13 indicate ambient manganese concentrations already exceed Montana water quality standards. The standard for manganese is also exceeded under all action Alternatives. In addition, Table 4-13 indicates the Montana water quality standard for nitrate is exceeded for Alternatives II, III, and IV, but is not exceeded for Alternative V. Therefore, based on the Agencies' analysis, Alternative V is better able to meet Montana water quality standards compared to Alternatives II, III, and IV.

Seepage Monitoring, Collection, and Pump Back System. An underdrain system would be included in the final paste design to collect drainage from the base of the free-draining paste facility. Depending on the final construction technique selected for the paste facility (Top-Down, Bottom-Up, or Combination option) the underdrain system would consist of one or more of the following elements: (1) basin drains to maximize recovery of seepage of residual process water in the paste and storm water infiltration through the paste, (2) a blanket drain adjacent to the outer slopes and beneath the compacted structural zone to maintain a drainage of the structural zone under the Bottom-Up or the combined option, (3) a finger drain system constructed beneath the paste facility to collect and route drainage to a single collection pond outside the main buttress, and (4) collection ponds to collect water pumped back to the paste plant and, if not needed for paste production, returned to the mill for reuse.

The volume of seepage from the paste facility would be significantly less than with alternatives involving deposition of the tailings as a slurry (Alternatives II, III, and IV), since most of the excess water would be removed with the tailing paste process. Monitoring of discharge rates and seepage quality from the underdrain system will be included in the monitoring plan to confirm seepage conditions during operations.

The ground water monitoring plan would consist of the installation of three types of wells: (1) upgradient monitoring wells to establish a potentiometric surface across the paste disposal area, (2) downgradient proximal monitoring wells immediately outside of the paste pile footprint area, and (3) downgradient compliance monitoring wells which would be located at the boundary of the ground water mixing zone to ensure compliance with MPDES limits. Bedrock ridges divide the paste pile into three separate groundwater basins. A downgradient monitoring well will be sited in the axis of each of these basins to provide early detection of water quality changes.

A system of pumpback wells (conceptually similar to the pumpback system proposed in Alternative IV) is included in Alternative V as a contingency. If operational monitoring data indicate MPDES discharge limits could not be met within the approved mixing zone, the pumpback system would be required by the Agencies to protect downgradient groundwater quality.

Mine Closure. Under Alternative V, mine adit water would be collected and treated prior to discharge to the Clark Fork River. Treatment would continue until the discharge meets effluent limits set forth by DEQ in the MPDES discharge permit. Seepage water collected in the paste facility underdrain system or captured in the pumpback system would also be treated until the discharge met effluent limits set forth in the MPDES permit. The project would require sufficient bonding to cover the possible need for long-term water treatment.

Surface Water Quantity

Evaluation Adit. Impacts from evaluation activities would remain the same as described for Alternative II. Additional detail is contained in the draft EIS.

Wilderness Lakes. Impacts to wilderness lakes related to fracturing and subsidence would be identical to those predicted for Alternatives III through IV (see **Geotechnical Engineering**). A long-term water monitoring plan is included for Alternative V, and includes monitoring lake levels at Cliff and Copper lakes. The subsidence control and monitoring plan will be coordinated with the fisheries/aquatics monitoring plans as presented under Alternative III in the draft EIS (also see the Alternative V description in **Chapter 2**).

Mill Facility and Makeup Water Requirements. Under Alternative V, process water would remain in an essentially closed loop. Approximately 5 to 10 percent of the flow in the process loop would be diverted to the wastewater treatment system and fresh water added to the circuit on an ongoing basis to prevent buildup of excess constituents in the process water. Process water for the mill would come from five sources: reclaimed tailings slurry water, mine discharge water, reclaimed concentrate slurry water, mill site and tailings paste facility site storm water, and if needed, make-up well water.

A make-up well as proposed under alternatives II, III, and IV and is still proposed under Alternative V. However, the production well would be relocated out of the Rock Creek alluvium to minimize or eliminate potential impacts to surface water resources in Rock Creek. In addition, the demand for water from the

proposed make-up water well under Alternative V would be reduced due to recycling of make-up-water from the paste plant and paste landfill seepage collection system.

Drainage and Surface Water. Construction of the tailings paste facility would alter the topography of about 325 to 330 acres in Miller Gulch, depending on the final construction technique used. The impact to surface water flow in Miller Gulch would vary depending upon the paste option implemented. The Top-Down option would reduce available flow sooner than the Bottom-Up option, but as areas became reclaimed surface flow from those areas would be returned to Miller Gulch. The Bottom-Up option would reduce flows in the southern fork of Miller Gulch immediately after mining commences, but would not impact the upper drainage until much later. The combined option would impound water for a longer period of time compared to other options discussed above. The actual duration that runoff to Miller Gulch would be affected depends upon how fast the facility was constructed, which option was used, and how fast the completed portions of the facility were reclaimed.

Mine Closure. Following completion of mining operations and after Agency review and approval of the mine closure plan, mine water would no longer be pumped from the underground workings. Until the underground workings filled with water to the elevation of the mine adit, water would not discharge from the mine. The length of time necessary for the underground working to fill with water and for water to once again discharge from the mine cannot be predicted with accuracy. Assuming inflows of 1,700 gpm and no outflow path other than the mine adit, the mine could take about 7 years to fill. If the upper ends of the adits were sealed near where they enter the mine workings, some water would likely flow from the underground workings through fractures in the surrounding bedrock. Water could reach the surface as springs and seeps if fractures were continuous, or could mix with groundwater, if present near the mine. However, it would be difficult to quantify the volume of flow or direction of flow using available hydrogeologic analyses.

Because of the uncertainties or inability to accurately predict ground water movement associated with the mine, the Agencies have committed to developing a comprehensive monitoring program and contingency and Corrective Action Plan. Based on geology and topography of the area surrounding the ore body, the Agencies have selected recommended monitoring locations which would be most likely to be influenced by such seepage. The precise locations of these monitoring sites will be determined based upon stream surveys to determine gaining/losing reaches and sampling site accessibility. These studies will be required of ASARCO, and the Agencies will require that a statistically representative number of samples at each location (e.g. monthly sampling during seasons when the sites are accessible for two or three years) be collected prior to commencement of mining by ASARCO.

Surface Water Quality

Adit and Mine Water, Waste Rock, and Milling Process. Mine water will receive treatment to remove suspended and dissolved solids, including ammonia nitrogen and nitrate/nitrite nitrogen, prior to discharge to the Clark Fork River through a submerged outfall located downstream of Noxon Dam. The mine water treatment system would include sedimentation, filtration, and nitrogen removal. Two different nitrate removal systems would be installed including an anoxic biotreatment system and a reverse osmosis treatment system. ASARCO expects that the biotreatment system would be the primary treatment system for most of the operating life of the mine water treatment system. However, the reverse osmosis system would be

available to provide primary treatment during the mine start up period, and to provide additional or backup treatment after the biotreatment system is up and operating.

Reverse osmosis technology and the proposed anoxic biotreatment technology have been proven to be capable of removing nitrate from water in a reliable manner. Reverse osmosis has been used for over 20 years throughout the world to successfully remove dissolved solids, including nitrate, from water flows comparable to that anticipated at the Rock Creek mine. Reverse osmosis has been used in a Lead, South Dakota mine since 1993 to remove nitrate from mine waste water on an intermittent basis at flow rates of approximately 200 gpm (pers. comm. with Wharf Resources personnel, August 21, 1997). In addition, reverse osmosis is currently being used to reduce nitrate concentrations (about 100 mg/L) from 100 gpm of mine water at the Kendall mine near Lewistown, Montana.

Anoxic biotreatment utilizing methanol as a carbon source has been used to provide nitrate removal in large drinking water treatment facilities under low temperature conditions in Europe for many years at flows comparable to that anticipated at the Rock Creek mine. Anoxic biotreatment is commonly used to remove nitrate from domestic waste water in the United States. The proposed anoxic treatment system is presently being demonstrated at the Stillwater Mine to remove nitrate from mine waste water with similar concentrations as the proposed ASARCO mine.

The proposed use of a dual technology system for nitrate removal at the Rock Creek mine appears to be both cost effective and environmentally acceptable. The proposed mine water treatment system would, if properly designed, constructed and operated, produce an effluent that meets the requirements of the revised draft MPDES discharge permit

As proposed, the mine water treatment system would remove suspended solids, heavy metals, and ammonia nitrogen and nitrate/nitrite nitrogen so that the requirements of the MPDES discharge permit can be met. The estimated water quality for discharges under Alternative V would be the same as for Alternative II (**Table 4-14**). However, it may be necessary to add phosphorus to the mine wastewater prior to anoxic biotreatment to promote growth of the de-nitrification bacteria. If this was determined to be necessary, the concentration of phosphorus in the treated effluent could increase over the untreated concentration. This increase is estimated to be less than 0.05 mg/l (Mark Reinsel, Hydrometrics pers. comm. to Gary Sturm, September 12, 1997).

Following completion of mining operations and after ammonium nitrate blasting is discontinued, the quality of the water within the mine, especially in terms of the quantity of ammonia nitrogen and nitrate/nitrite nitrogen, would improve. The monitoring plan would include the collection of additional water quality data from the ASARCO Troy Mine for comparison purposes. However, water treatment would continue for any surface discharge until such time as the quality of the mine water discharge or collected seepage from the paste facility, if any, was acceptable for discharge to the Clark Fork River without treatment.

Accidental Spills and Ruptures. Potential environmental consequences resulting from ruptures or breaks in pipelines and the accidental rupture of a supply or tanker truck are the same as presented for

Alternative II in the draft EIS. Alternative V includes several mitigations which reduce the potential for impacts from ruptures or breaks in pipelines and spills associated with transport of the ore concentrate.

Larger diameter pipelines (16- to 24-inch) between the mill and the paste plant are proposed to accommodate a higher water content in the tailings slurry. Because of the potential for tailings and concentrate to produce abrasion wear, dual wall steel/polyethylene (PE) pipe is proposed for Alternative V pipelines. With this type of pipe, the inner PE liner can be monitored and replaced as necessary if abrasion wear is a significant factor. High sensitivity leak detection would be utilized with this type of pipe, allowing detection of small amounts of seepage. In addition to leak detection, the proposed pipelines would have pressure monitoring which would automatically shut down pumps in the event of pipeline failure. All pipelines would be buried except at stream crossings and covered with 24 inches of soil. This would reduce the potential for breakage and rupture of the pipeline. In the remote case where both the inner liner and outer pipe were ruptured the soil surrounding the pipe would help to contain the spill until the monitoring system shut the pipeline down. The pipe between the break and valve at the mill would continue to discharge until the pipe is empty.

Truck hauling of concentrate from the mill to the rail loadout facility would be replaced by pipeline transport of the concentrate. Concentrate would be sent from the mill to the rail loadout facility as a slurry in a 3-inch dual-walled steel pipe with leak detection sensors and buried in the same corridor as the tailings and water pipelines. This would eliminate eight trucks per day making the round trip between the mill and the loadout facility.

The rail loadout process including concentrate thickening, filtering, and storage and railcar loading would take place in an enclosed building to prevent contamination of the ground and surface runoff.

Sedimentation. Issues related to increased sedimentation would be the same as presented in the draft EIS for Alternative IV. The 300-foot buffer around the mill site, fewer miles of new road construction and reconstruction, as well as implementation of a sediment source identification and mitigation plan would help reduce sediment impacts.

Some aspects of the paste construction method help to minimize sediment losses. These include reduced surface disturbance prior to tailings paste deposition, modified storm water control features within and around the paste facility site, and smaller active working areas (unreclaimed). In addition, use of the paste facility rather than a tailings impoundment would allow concurrent reclamation of tailings paste as construction of the facility progresses, thus reducing the potential for sedimentation in comparison with other proposed alternatives. Depending on the method of deposition selected by the agencies the timing of reclamation activities varies (see **Soils and Reclamation**). In all three paste facility construction options, storm water controls and sedimentation mitigation BMPs are required and would be in place prior to initiation of construction activities to protect against sedimentation impacts to receiving waters.

R1-WATSED modeling results for Alternative V actions show no increase in peak flows and a 30 percent increase in annual sediment yield during the life of the mine. At the end of the life of mine, the peak flow value would drop one percent below the existing value and the annual sediment increase is predicted to

drop by 20 percent. Because this would result in a small overall decrease within the watershed, it is expected that conditions would continue to remain the same or slightly improve with the implementation of this alternative.

Tailings Paste Facility Failure. As presented in the draft EIS for alternatives III and IV, the agencies would institute a process to review and evaluate ASARCO's final paste facility design to ensure long-term stability, and minimize the probability of failure. The proposed Alternative V paste facility eliminates the type of catastrophic failure potential discussed under Alternatives II, III, and IV (see **Geotechnical Engineering**). In addition, environmental consequences due to transport of material as a result of damage to the facility is essentially negligible due to the dewatered state of the paste. Inherent in the design of the placement of dewatered paste is the tendency for the material to be contained and able to be graded or re-worked if slumping or fracturing occurred. As discussed in **Geotechnical Engineering**, even if there was a mass failure of the paste facility, the relatively high viscosity of the paste would be sufficient to retard flow over any appreciable distance. Conditions which could change the character, and hence the behavior of the paste tailings include a change in moisture content of the paste. However, there would need to be a significant increase in moisture content throughout the entire paste deposit before overall stability would be compromised. This increase in moisture would not be expected with the strict quality control program that would be implemented by the Agencies.

Clark Fork River. The Priscu report (Priscu 1989) evaluated the potential impact of the Rock Creek Project on nutrient levels in the Clark Fork River assuming 2,000 gpm of adit water and 350 gpm of tailing seepage without any discharged directly to the Clark Fork River treatment prior to discharge. The report noted that existing algal biomass levels in the Clark Fork River at the time of the study exceeded conditions that were aesthetically acceptable, but because the Clark Fork River appears to be phosphorus limited, additional nitrogen loading from the Rock Creek Project was predicted to not have a major influence on the magnitude of the attached algal productivity and biomass in the Clark Fork River. However, the potential for minute increase in phosphorus and nitrates from the biotreatment process could increase algal mass in the Clark Fork River by an undetermined amount. Any increase in the loading of phosphorus would need to comply with the TMDL requirements of the MPDES permit, and must not degrade water quality in Idaho’s Clark Fork River. Under Alternative V, the reverse osmosis treatment system may need to be used as a polishing step to ensure TMDL requirements can be met.

Lake Pend Oreille. The 1989 Priscu report noted that total nitrogen levels in Lake Pend Oreille would increase about 7.6 percent, and that chlorophyll would increase by about 1.5 percent under the conditions assumed above. The report concluded that while this level of change could be calculated, it could not be measured given the intrinsic spatial and temporal variability of chlorophyll in the lake. Because Lake Pend Oreille is phosphorus limited, and because the greatest potential nutrient impact of the proposed project would be an increase in nitrogen, the report concluded that no significant algal blooms would be expected.

Any increase of phosphorus loading to Lake Pend Oreille must comply with the TMDL requirements of the MPDES permit and must not degrade water quality in Lake Pend Oreille. Algal blooms in Lake Pend Oreille are not expected under Alternative V loading conditions, particularly because river water mixes with the benthic portion of the lake. This conclusion is supported by a 1993 EPA report. As part of the 1993 EPA report a nutrient load-lake response computer model was used to aid in predicting the effect nutrient

levels could have on the lake. Computer simulations indicate that the trophic state of the lake's pelagic waters would be little changed by small to moderate alterations in the amount of nitrogen and phosphorus entering the lake. Maintenance of open lake water quality is largely dependent upon maintaining nutrient discharges from the Clark Fork at or below their present levels.

Storm Water Control

Proposed storm water control measures for the Alternative V action have been modified from those presented for all other options. All detention and retention ponds would be lined with a 30-mil HPDE liner to provide primary seepage containment and reduce impacts to ground water underlying and adjacent to the proposed facility. All detention and retention ponds would be sized to contain the 100-year / 24-hour storm event, thus reducing impacts to surface waters in the area. The proposed paste facility would include an underdrain and collection system to provide secondary containment of storm water seepage through the tailings paste facility, again reducing potential impacts to ground water underlying and adjacent to the proposed facility.

Storm water collected at the adit portal and mill sites would be collected and recycled for mill use. Storm water collected from the outer slopes of the mill pad and the mill site underdrains would only be allowed to discharge as specified by the MPDES permit. Otherwise collected storm water would be pumped back to the mill for reuse.

Proposed surface water control structures associated with the paste facility would significantly reduce potential impacts of increased sedimentation to surface waters and drainages during the operational phase of the proposed activity. The proposed storm water control measures for the paste facility area would include two lined storm water ponds constructed at lower elevations in the tailings disposal site and sized to handle the runoff from the active portion of the landfill site during a 100-year/24-hour storm event. Settling ponds would be constructed on the upper portion of paste facility and lined to prevent seepage into paste. Limiting unreclaimed areas to the active disposal areas would minimize sediment and runoff. Water collected in the storm water pond could be pumped to the paste plant and then to the mill as process water or used to irrigate reclaimed portions of the paste facility. Storm water from undisturbed lands above paste facility would be diverted around active portions of paste facility, to north fork of Miller Gulch and to Rock Creek during mine operations. Runoff from reclaimed areas of paste facility would be routed to settling basins before mixing with runoff from undisturbed areas.

Cumulative Impacts

The KNF Cedar Gulch timber sales in the Rock Creek watershed and unknown private logging potentially may increase peak flows. The amount of these peak flow increases would depend on timing and site specific information that are unknown at this time. Additional sediment could reach Rock Creek and the Clark Fork River from logging operations. If these practices were properly implemented and maintained, then additional sediment transport into the drainages would be minimized. Proposed highway construction also may increase sediment reaching streams potentially affected by the ASARCO Project.

Also as part of the 1993 EPA report Idaho researchers concluded that phosphorus is the primary nutrient controlling algal and plant growth in Pend Oreille Lake. Phosphate in detergents is the source of much of the phosphorus discharged to municipal treatment plants, and approximately half of all soluble phosphorus loading to the Clark Fork River originates from wastewater discharges. Bans on the sale of phosphate detergents are already in effect in Montana in the Flathead River Basin, and in the communities of Missoula, Superior and Alberton as part of voluntary implementation of the Tri-State implementation's Proposed Plan. Bonner County, Idaho, has also adopted a phosphate detergent ban. These actions have been highly successful in reducing phosphorus discharges to the Clark Fork River from the respective municipal wastewater treatment facilities. For example, the phosphate detergent ban that was implemented by the City of Missoula in May 1989 resulted in greater than a 40 percent reduction in the phosphorus loading to the Clark Fork from the Missoula wastewater treatment plant. Concentrations of phosphorus in the river downstream of this facility have subsequently declined by a large margin. A modeling study conducted by the University of Montana predicted a reduction in algal standing crops in 110 miles of Clark Fork River as a direct result of this action. The increase of phosphorus loading from the Rock Creek discharge could minimally reduce these upstream efforts.

No cumulative impacts would occur to ground water in the project area. The impacts of the proposed project would be limited to the vicinity of the project area, and the Rock Creek tailings impoundment site. No ground water effects would result from the proposed KNF timber sales. The Montanore Project includes underground mining and would affect bedrock ground water systems east of the proposed Rock Creek Project. However, it does not appear likely that the two operations would have any cumulative effects on ground water quantity or quality. In addition, no cumulative impacts are predicted as it related to TMDL requirements because these requirements would necessarily be equal to or more stringent than existing water quality standards. Cumulative impacts from WWP prelicensing are not expected because the operation of the dam is not expected to be significantly different than during the baseline period of measurement.

WATERS AND WETLANDS OF THE U.S.

Summary

None of the alternatives would affect more than 1.5 acres of Waters of the U.S. Variable amounts of wetlands are directly and indirectly affected but no more than 8.1 acres under any alternative.

Approximately 1 acre of wetlands associated with the proposed tailings impoundment/paste facility site for all action alternatives would be indirectly affected by the potential capture of surface water by the tailings impoundment and wet paste disposal system. The total drainage area contributing to wetlands would be reduced, potentially reducing the duration of saturation, inundation, and ponding of water in this area. Decreased surface and ground water flow, especially during the growing season or dry periods, would allow vegetative species more tolerant of drier sites to replace species requiring more moist site conditions.

Sediment would temporarily increase in Waters of the U.S. and wetlands during construction under all action alternatives. Proposed BMPs would help reduce sedimentation. Mitigations under alternatives III, IV, and V would further reduce sedimentation in Rock Creek.

ASARCO has proposed mitigation plans (ASARCO, Incorporated 1995, 1997) to create wetland acres to compensate for the unavoidable loss of wetlands resulting from implementing the various action alternatives. Alternative II would result in approximately 12.3 acres of created wetlands for mitigation of the loss of about 8.1 acres of wetlands directly and indirectly affected. Under Alternative V, about 7.0 acres of wetlands would be created at three sites identified as (1) Miller Gulch Tributary, (2) Upper Rock Creek, and (3) Lower Rock Creek to compensate for the loss of about 6.6 acres of directly and indirectly affected Waters of the U.S. and wetlands.

The functions and values of the wetlands impacted by the Rock Creek mine would be destroyed or reduced. The definitive wetland mitigation ratio (acres mitigated per acre destroyed) and specific wetland mitigation designs and locations have not been approved by the U.S. Army Corps of Engineers (COE). Replacement (mitigated) wetland functions and values would be monitored during mining to evaluate the success of re-establishing functions and values of wetlands destroyed.

General Introduction

The proposed project would affect Waters of the U.S. and wetlands in the mill site, waste rock dump, access roads, utility corridors, topsoil stockpiles, diversion ditches, and tailings impoundment areas (see **Table 4-18**).

In general, the functions and values of wetlands impacted by the Rock Creek project may be considered limited for regional importance because wetlands commonly occur throughout the region and their loss would not limit aquatic or wildlife habitat for the region. In addition, the proposed wetland mitigation would create wetlands that would re-establish similar wetland functions and values. Site-specific importance was rated high for aquatic and wildlife diversity and abundance. Other wetland functions and values discussed in Chapter 3 were rated as having only moderate to low importance.

TABLE 4-18
Acreage of Wetlands and Waters of the U.S. Affected by Proposed and Alternative Facilities

ALTERNATIVE IMPACTS	Wetlands (acres)		Waters of the U.S. (acres)	
	Direct	Indirect	Direct	Indirect
ALTERNATIVE II				
ASARCO mill site area	0.3	0.0	1.1	0.0
ASARCO mill site waste rock dump	0.6	1.3	0.0	0.0
Access road upgrade (FDR No. 150)	<0.1[1]	0.0	<0.1	0.0
Utilities corridor (powerline/pipelines)	0.2	0.0	0.3	0.0
Rock Creek tailings impoundment	4.4	1.0	0.0	0.0
Topsoil stockpiles and diversion ditches	<0.1	0.0	0.0	0.0
Excess mine water pipeline	<0.1	0.0	0.0	0.0
Alternative II Totals	**5.8**	**2.3**	**1.5**	**0.0**
ALTERNATIVE III				
Alternative III Totals	**5.2**	**1.0**	**1.5**	**0.0**
ALTERNATIVE IV				
Alternative IV Totals	**5.2**	**1.0**	**0.4**	**0.0**
ALTERNATIVE V				
Confluence Mill Site and Waste Rock Dump	<0.1	0.0	0.0	0.0
Access road upgrade (FDR No. 150)	<0.1	0.0	<0.1	0.0
Utilities corridor (powerline/pipelines)	0.2	0.0	0.3	0.0
Wet Paste Tailing Disposal	4.6	1.0	0.0	0.0
Topsoil stockpiles and diversion ditches	<0.1	0.0	0.0	0.0
Excess mine water pipeline	<0.1	0.0	0.0	0.0
Alternative V Totals	**5.2**	**1.0-**	**0.4**	**0.0**

[1] <0.1 acres rounded up to 0.1 acres for acreage totals

Alternative I

Waters of the U.S. and wetlands are located along Rock Creek, its tributaries, and along the ephemeral and intermittent drainages of Miller Gulch. These Waters of the U.S. and wetlands would be impacted under Alternative I as a result of possible timber harvests; potential land exchanges; probable increased recreational use, including hunting, fishing, camping, and recreational driving; and the Montanore Mine. These impacts may decrease the amount of Waters of the U.S. and wetlands, increase erosion and sedimentation in the Rock Creek drainage by some amount, and reduce their ecological functions. The most important wetland functions are considered to be their role in providing aquatic and wildlife diversity and abundance.

Alternative II

Construction of ASARCO's proposed mill site, mine waste rock dump, tailings impoundment, and associated facilities would affect a total of 5.8 acres of wetlands by the direct placement of fill, and an additional 2.3 acres of wetlands by modifying existing hydrology. Surface water flow would be reduced in wetlands downstream of both the proposed waste rock dump and mill site from the diversion of runoff.

About 1.1 acres of Waters of the U.S. would be directly affected by the construction of lined channels to route existing drainage flow through the mill site. Construction of utility corridors and of the new segment of FDR No. 150 from Montana Highway 200 would require filling 0.3 acres of wetlands (see **Table 4-18**) and would directly affect 0.4 acres of Waters of the U.S.

About 4.4 acres of wetlands located under the proposed tailings impoundment would be destroyed by direct filling with tailings materials. These wetland areas are associated primarily with ephemeral drainages of the south fork of Miller Gulch and occur in subtle surface depressions along the broad shallow grassy swales. Saturated soils are caused by shallow perched water in surficial clays. Static water levels in nearby monitoring wells indicate that the water table is about 20 feet beneath ground surface. Wetlands vegetation in this area is dominated by herbaceous species including sedge and rush species. The functions and values associated with these wetlands would be destroyed. Loss of these functions and values would be significant.

About 1 acre of wetland, immediately downgradient of the proposed tailings impoundment, would be indirectly affected by the capture of surface water by the tailings impoundment, and the surface and ground water capture of the proposed tailings impoundment seepage collection system. The total drainage area contributing to downstream wetlands would be reduced under Alternative II, potentially reducing the frequency and duration of saturation, inundation, and ponding of water for some wetlands. Decreased surface and ground water flows, especially during the growing season or dry periods, may allow vegetative species more tolerant of drier sites to replace species requiring more moist site conditions. This may result in a reduction in wetland functions, primarily from the loss of wildlife habitat diversity.

Sediment contributions would temporarily increase to Waters of the U.S. and wetlands during construction of the proposed mill site, roads, and tailings impoundment. BMPs would reduce sediment contributions to Waters of the U.S. and wetlands.

Impacts to Waters of the U.S. and wetlands under Alternative II would be potentially significant in the short term.

Wetland Mitigation Plan (Alternative II)

In compliance with Section 404(b)(1) of the Clean Water Act, ASARCO has proposed a mitigation plan providing mitigation and compensation for the loss and potential diminishment of wetland functions and values associated with development of the proposed project (ASARCO, Incorporated 1993). A summary of ASARCO's proposed wetlands mitigation plan is found in **Chapter 2**. In its wetlands mitigation plan, ASARCO proposes to create 12.3 acres of wetlands to compensate for a wetlands loss of about 8.1 acres. About 1.5 acres of Waters of the U.S. (primarily without vegetated wetlands) would be affected by the proposed project and would be mitigated by creating 1.5 acres of Waters of the U.S. on site during final reclamation. The primary functions and values of the created wetlands would be to re-establish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek, and attenuate peak flows.

ASARCO identified four possible wetland mitigation areas and one Waters of the U.S. mitigation site. The proposed acreages and mitigation schedules for the created wetlands and Waters of the U.S. are provided in **Table 2-7.** Detailed description, including site development, design specifications, and schedules, are presented in ASARCO's original wetlands mitigation plan (ASARCO, Incorporated 1993). The proposed wetlands and Waters of the U.S. mitigation consists of creating: 1) 7.5 acres of wetlands at borrow area 3; 2) 1.8 acres of wetlands at the access road sites; 3) 1.2 acres of wetlands at the Miller Gulch sites; 4) 1.8 acres of wetlands at the Rock Creek sites; and 5) 1.5 acres of Waters of the U.S. at the proposed mill site. All proposed wetland and Waters of the U.S. mitigation sites are within the proposed permit boundary.

The technique of controlling wetland hydrology through elevated culverts and standpipes has been used successfully at numerous wetland construction projects. The proposed wetland mitigation, if successfully established, could provide wetland functions and values to compensate for the loss and potential diminishment of wetland functions and values associated with development of Alternative II. This could reduce the impact to wetlands and Waters of the U.S. below significance in the long-term.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Wetland Mitigation Plan (Alternative V)

ASARCO has provided a revised wetland mitigation plan to specifically address Alternative V (ASARCO Incorporated 1997). Implementation of Alternative V would result in the loss of about 6.2 acres of wetlands and 0.4 acres of Waters of the U.S. In the revised wetlands mitigation plan, ASARCO proposes

to create 7.0 acres of wetlands to compensate for a total loss of 6.6 acres of Waters of the U.S. and wetlands. The primary functions and values of the created wetlands would be to re-establish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek, and attenuate peak flows.

Alternative V would result in essentially the same impacts to Waters of the U.S. and wetlands as Alternatives III and IV. One difference with Alternative V would be a time delay for the impacts to wetlands associated with tailings disposal. Alternative V could result in up to a 25 year delay in the impacts to some wetland areas depending upon the paste construction option used compared to constructing the entire tailings impoundment at the start of the mining project. Successful re-contouring and reclamation of each completed paste tailings panel would also help minimize the cumulative amount of wetland areas that would be impacted during each phase of the mine project. Another primary difference with the revised wetland mitigation plan for Alternative V is the elimination of the 7.5 acre “Borrow Area 3" and the addition of the 1.4 acre Lower Rock Creek site.

ASARCO has identified three main wetland mitigation sites along with three additional wetland sites (see **Figure 2-33**). The proposed acreage and mitigation schedules for the created wetlands are provided in **Table 2-14**. Detailed descriptions, including site development, design specifications, and schedules, are presented in **Appendix N** and in ASARCO's revised mitigation plan (ASARCO Incorporated 1997). The proposed wetlands mitigation consists of creating: 1) 1.2 acres of wetlands at the Miller Gulch Tributary site; 2) 4.4 acres of wetlands at the Upper Rock Creek site; and 3) 1.4 acres of wetlands at the Lower Rock Creek site. All proposed wetland mitigation sites are within the proposed permit boundary.

At the mill site, surface runoff from undisturbed hillsides above the mill facilities would be diverted around the mill site and discharged into the natural channel that drains into the East Fork Rock Creek. The diversion would be designed to handle the 100-year rain-on-snow event.

Impacts to approximately 6.6 acres of Waters of the U.S. and wetlands under Alternative V would be potentially significant in the short term.

Additional Waters of the U.S. and wetlands delineation work was performed in the Cabinet Mountain Wilderness Area to address potential impacts from mine dewatering and area-wide subsidence. The Waters of the U.S. and wetlands were delineated around Copper Lake, Cliff Lake, and four potential subsidence areas over the ore body by ASARCO in August 1996. A total of 3.5 acres of Waters of the U.S. and wetlands (including the lake’s surface area) were identified within the two lake areas. An additional 0.5 acres of Waters of the U.S. and wetlands were identified within two of the four potential subsidence areas. The potential for impacts to these Waters of the U.S. and wetland areas from the mine dewatering and area-wide subsidence was considered to be very unlikely because the lakes are located at least 900 feet above the ore body and are hydrologically separated from the regional water table by an unsaturated zone hundreds of feet thick. Also, ASARCO does not plan to mine the pillars which will help reduce the potential for area-wide subsidence.

Cumulative Impacts

The impacts of implementing any of the action alternatives, combined with impacts from the Montanore Mine and projected timber sales in the Rock Creek drainage may decrease the amount of Waters of the U.S. and wetlands and their ecological functions in the vicinity of the CMW. Aquatic and wildlife diversity and abundance are the two most important functions of Waters of the U.S. and wetlands in the immediate area. The wetland mitigation plans could create wetlands that would help re-establish wetland functions to compensate for the loss and potential diminishment of habitat diversity and abundance. Under alternatives III, IV, and V, timber sales or associated road construction on KNF lands within the Rock Creek drainage may be reduced in scope and number until after mine closure, thus reducing cumulative impacts to Waters of the U.S. and wetlands. Alternative V could result in an up to 25 year delay for some impacts to wetlands within the tailings disposal footprint area depending on the paste construction option used. In addition, successfully re-contouring and reclaiming of each successive paste panel should help minimize the total cumulative impacts to wetlands. Cumulative impacts under all action alternatives would be potentially significant in the short term until wetland mitigation sites were successfully established.

AQUATICS/FISHERIES

Summary

Some impacts to water quality are possible as a result of mine construction and operation for all action alternatives. Impacts to water quality may affect fish and aquatic macroinvertebrates and plants. The impacts may include a reduction in numbers of individual organisms, a change in species composition, a reduction in species diversity, or a combination of the above. In general, all action alternatives would have these potential impacts. However, Alternative II tends to have the greatest impacts, and Alternative V the least.

Catastrophic failure of the tailings impoundment or paste facility would have potentially disastrous consequences for aquatic life in downstream water bodies under all action alternatives. Failure of the tailings paste facility under action Alternative V would have reduced risk of failure and reduced potential for tailings to reach the river because of the reduced mobility of the paste material (see ***Geotechnical Engineering****).*

Spills of fuels, chemicals, concentrate, or reagents could occur and have toxic effects on aquatic life if they reached water. Such events would be rare and impacts relatively short-lived. Long-term impacts would depend on the quantity and toxicity of spilled materials.

A slurry, waste water, or reclaim water pipeline rupture could result in tailings, mine adit waste water, or reclaimed water from the tailings impoundment polluting Rock Creek. The extent of harm depends on quantity and toxicity of tailings or waste water entering the stream, the flow of the stream at the time of the spill, and the spill's location. Risks to the Clark Fork River are somewhat less than to Rock Creek because of the dilution potential of the larger water body. The potential for tailings pipeline rupture and spills in the West Fork Rock Creek would be substantially reduced under Alternative V.

Clearing in the Rock Creek riparian zone for road, slurry line, and powerline construction could increase streambed sediments and water temperatures. Depending on the alternative, stream habitat could be directly altered by construction of the mill site, bridges, utility corridors, and pipeline crossings.

If mining results in reduced water levels in the wilderness lakes(Cliff and Copper Lakes) , amphibians and other aquatic life would be impacted. There are no known fish populations in these lakes. The potential for subsidence-related impacts to water levels and aquatic life in these lakes would be reduced under Alternative V.

Aquatic habitat degradation could result in non-native fish gaining a competitive advantage over the native species. Brook trout are the primary threat. They interbreed with bull trout and the offspring are sterile. It is generally believed that such a mating is detrimental to bull trout populations. Sediment mitigations in Rock Creek under Alternative V could reduce project-related impacts to resident Rock Creek bull trout and westslope cutthroat trout and to Cabinet Gorge Reservoir bull trout. Sediment mitigations in the Bull River drainage under Alternative V could reduce existing sediment-related impacts to Cabinet Gorge Reservoir bull trout.

Increased recreational use and access in the area could result in increased fishing pressure. Potential impacts to Rock Creek from increased fishing pressure would be minimal.

Alternative I

Aquatic resources would change over time due to natural cycles. A Forest Service timber sale is planned for the project area. Road construction associated with this sale and other timber sales or development on private land in the drainage could impact fisheries resources by increasing sediment loads, changing flow patterns, and increasing water temperatures. Resident bull trout in Rock Creek could be harmed if deposited sediment in spawning areas increased. Migratory bull trout, although probably rare in Rock Creek, could also be adversely impacted by deposited sediments in spawning areas. Impacts to aquatics/fisheries resources in Rock Creek under Alternative I would have the potential to become significant if deposited sediments were increased.

Alternative II

Aquatic Habitat

Spills and Impoundment Failure. If the slurry, waste water, or reclaim water pipeline ruptured it could result in tailings, mine adit waste water, and/or reclaimed water from the tailings impoundment reaching surface waters (see **Hydrology**). The amount of harm this would cause depends on the amount and toxicity of material actually reaching the stream, and streamflow at the time of the spill. Location of the spill would also be important -- the further upstream the spill, the greater portion of Rock Creek potentially impacted. The risks to the Clark Fork River are somewhat less because of the dilution potential of the large water body and higher hardness of the river water. Impacts to aquatics/fisheries resources in other water bodies from these improbable events would be minor.

ASARCO's Troy Mine, located in a drainage adjacent to Rock Creek, suffered a tailings slurry line spill in 1984, resulting in about 400 tons of mine tailings entering Lake Creek (Jones 1984). Macroinvertebrate data collected at the time of the spill were compared to baseline data collected seven years earlier (Hansen 1990). The differences in experimental design between the two survey periods did not allow a rigorous quantitative analysis to be made. However, it appeared that differences in species abundances were due to tailings contamination, although it was not possible to separate the effects of the tailings impoundment seepage from the tailings spill. None of the biotic changes in Lake Creek up to July 1985 appeared to be extreme enough to risk local extinction (Hansen 1990). Research on Lake Creek since 1986 indicates no major long-term impacts to macroinvertebrates from the tailings spill or tailings impoundment seepage (Parametrix 1997). The long-term impacts to Lake Creek from this accident appear to be negligible. Although ASARCO is proposing several safety features to reduce the likelihood of spills (including emergency dump impoundments and pipeline sensors), the possibility of accidents cannot be eliminated.

Some of the reagents proposed for use in the milling process are known to be toxic to aquatic organisms. (Annual consumption of reagents is listed in **Appendix F**.) For example, the acute toxicity of potassium amyl xanthate to rainbow trout is 18 - 56 ppm (Webb et al. 1976). Chronic toxicity testing (static type test) found 100 percent mortality of rainbow trout exposed to a concentration of 56 ppm potassium amyl xanthate for less than 4 days. During flow-through toxicity tests, which better approach natural conditions, toxicity of xanthates was on the order of 100-fold greater than the level suggested by the static toxicity test results (Ibid.). The results of these flow-through tests suggest that xanthates are potentially harmful to rainbow trout populations at concentrations that may be encountered in receiving waters near mining operations. Webb et al. (Ibid.) cite research that found xanthates in tailings effluent in the range of 0.2 - 4.0 ppm. Xanthate residues at this level in the tailings would be cause for concern if tailings were to leak or be spilled in Rock Creek.

a-Terpinal (pine oil) has an acute toxicity (LC_{50}) to rainbow trout in concentrations of 10 ppm (Webb et al. 1976). Dow 250 (polypropylene glycol) is relatively non-toxic to rainbow trout (LC_{50} > 1000 ppm) (Webb et al. 1976). The toxicity to aquatic life of the other reagents to be used in the mill ranges from relatively non-toxic (Orzana A) to moderately toxic (Am Cy Superfloc S-5595) (see **Appendix F**).

The most likely, but still improbable, chemical accident would be a spill of one of the processing reagents into a stream while being hauled by truck to the mill site. It is possible that such an event could cause a fish kill and eliminate the aquatic macroinvertebrate and algae community in the vicinity of the spill. Such events would be rare and impacts relatively brief.

Concentrate would contain copper, silver, and residues from processing and would be shipped from the mill to the railroad in trucks. If a truck were to overturn, or a train derail, concentrate could spill into Rock Creek or the Clark Fork River. Both copper and silver are toxic to fish. Silver is one of the most toxic metals to aquatic life (Phillips and Russo 1978). Impacts to aquatics/fisheries from accidental spills could be potentially significant depending on the location of the spill and the quantity and characteristics of the material spilled.

Of the several low-probability spill events that could have an impact on aquatic ecosystems, the least likely but most catastrophic would be a failure of the tailings impoundment (see **Geotechnical Engineering** and **Hydrology**). If this were to occur, sediments and tailings leachate would be uncontrollably released into Rock Creek and the Clark Fork River. Water quality degradation associated with the unlikely event of an impoundment failure is discussed in **Hydrology**. The toxicity of ammonia, nitrate, copper, and lead (pollutants found in the tailings) to aquatic life depends on a number of variables including, but not limited to, concentration, temperature, hardness, and pH. Therefore, the impacts to aquatic life in the event of an impoundment failure cannot be accurately predicted.

At the Troy Mine, acute toxicity tests have been conducted with tailings pond water and *Daphnia magna* (an invertebrate test organism) during the mine operation and current shutdown. From the start of the operation to the summer of 1991, death of 50 percent or more Daphnia occurred in 9 of 29 tests. Since that time, the tailings decant water was similarly toxic (> 50% mortality) in 25 of 28 tests (Parametrix 1994). Toxicity during the latter part of the operation is believed to be caused primarily by elevated levels of ammonia, copper and other metals (ASARCO Incorporated, 1987-1994). Based on the Troy toxicity data, it is likely that the Rock Creek impoundment tailings water would be toxic to aquatic life in the event of an impoundment failure, especially if the failure occurred a few years after the operation began.

In the event of a spill, the impact to the lower 1.0 mile of Rock Creek would be the most severe because of the relatively low flow and soft water in Rock Creek. The Clark Fork River contains harder water and is therefore somewhat less sensitive to metals pollution. In addition, the substantially larger flow of the Clark Fork River provides significant potential for dilution of pollutants. The tailings liquid, which would have elevated levels of ammonia and nitrate, could impact aquatic life downstream to Lake Pend Oreille via direct toxic effects and/or by increasing algal growth. The tailings solids, which would have elevated levels of copper and lead, would tend to be transported along the bottom of Rock Creek, although finer particles could be transported in suspension. The spatial extent of the downstream effects are dependent on the creek flow rates and the particle size distribution of the tailing solids. Fine particles and their associated pollutants could impact aquatic life as far downstream as Lake Pend Oreille.

Impacts to aquatics/fisheries from an impoundment failure could be substantial and significant in the short term to the lower 1.0 mile of Rock Creek and to the Clark Fork River, depending on seasonal, locational, and operational variables. Long-term impacts from an impoundment failure would be less but

potentially significant depending on the same variables. Aquatic systems downstream to Lake Pend Oreille could experience significant short-term impacts from the addition of nitrate and ammonia in solution. Long-term impacts to Lake Pend Oreille would depend on the rate and quantity of metals and sediments that passed Cabinet Gorge Dam, but could be potentially significant.

Sediment. Impacts can be quantified from both suspended sediment (TSS) and deposited sediments. Assuming the implementation of BMPs, the estimated temporary increase in TSS in Rock Creek resulting from the project is between 7 and 33 percent during the exploration and construction phase (see **Hydrology**). TSS is estimated to average 4 mg/L, which is considerably less than 20 mg/L, the level considered by the State of Montana to be "highly protective" of cold-water fisheries (Montana Department of Health and Environmental Sciences 1988). As disturbed areas are revegetated and stabilized, concentrations of suspended sediment would decrease. However, soil disturbed by construction activities would provide favorable sites for the spread of noxious weeds (see **Biodiversity**). Runoff and sediment yield are higher on sites infested with spotted knapweed (see **Chapter 3, Biodiversity**).

The impact of increased suspended sediments on fisheries resources is difficult to quantify. Data indicate that suspended sediment concentration alone is a relatively poor indicator of suspended sediment effects; concentration plus duration of exposure is a better indicator of effects (Newcombe and MacDonald 1991). Major impacts (decreased growth rate or increased mortality) to salmonids have occurred from exposure to suspended sediment concentrations of less than 20 mg/L (Slaney, Halsey, and Tautz 1977; Sykora, Smith, and Synak 1972). The impacts of suspended sediment on fish in Rock Creek would depend on variables such as the concentration of sediment, duration of exposure, species and life stage of fish exposed, season, streamflow, and water temperature.

The impact of deposited sediment is also difficult to quantify, because it is not possible to predict accurately the amount of sediment that would be deposited on the stream bottom. Sediment can reduce the quantity and diversity of aquatic macroinvertebrates, which provide food for salmonids. Decreased aquatic insect populations have been noted below silt outflows (Bjornn et al. 1977; Nuttall and Bielby 1973, and others). The distribution of aquatic macroinvertebrates inhabiting running water environments is highly dependent on substrate particle size (Cummins and Lauf 1969).[1] Increased levels of deposited sediment could reduce the quantity of aquatic macroinvertebrates (the food supply for fish) in Rock Creek in the short term. In addition, a change in species composition may occur, with increases in the abundance of sediment-tolerant species and decreases of abundance of sediment-intolerant species.

Sediment may adversely impact salmonid reproductive processes by modifying spawning time, place, and behavior. In addition, sediment deposition on the stream substrate can impair egg and larval growth, development, and survival (Wilber 1983).

[1]McClelland and Brusven (1980) found that increased quantities of sediment in laboratory streams filled substrate interstices (the cracks in between the rocks) and reduced the "effective" size of surface cobbles. The sediments effectively eliminated many of the critical static (calm) water areas around cobbles and boulders, reducing insect density. Fine sediments around cobbles produce a "gasket effect" by creating a seal, thereby restricting access to the undersurface of cobbles (Brusven and Prather 1974).

On the Flathead National Forest, a 40 percent sediment (less than 0.25 inches) level in bull trout spawning areas is considered to be an upper tolerance limit. Once sediment exceeds that level, no additional sediment loading from new land disturbances is allowed, and a program of sediment source reduction is undertaken. Very little spawning habitat is available in Rock Creek. The median percentage of fine sediment in spawning gravel located just downstream of Engle Creek was 43 percent in 1993, while the median percentage for the years 1988 to 1991 was 25 percent. Any increase in deposited sediment in these spawning substrates would further reduce survival-to-emergence of fry and potentially lead to reduction of fish populations due to reproductive failure. Over time, sediment levels would decline as disturbed areas stabilized and revegetated.

Road construction and logging for roads, pipelines, and powerlines could potentially increase the percentage of fine sediments in Rock Creek. ASARCO has committed to use best management practices (BMPs) when constructing roads and logging. However, BMPs may not eliminate all sediment production (Mathieus 1996). An audit of the implementation and effectiveness of forestry BMPs (which included road construction) conducted in Montana in 1996 found that overall compliance with BMPs was high (92% of the practices rated on all sites were applied correctly and in the proper locations). High risk BMPs (those BMPs that are most important for protecting watersheds) were applied less consistently on Federal lands - 85% met or exceeded minimum requirements. On federal lands, 83% of the sites examined had minor departures from BMP application guidelines, while 33% had major departures. The effectiveness of BMPs was also less than perfect. On federal lands, 84% of the high risk BMPs provided adequate protection for the watershed, 9% had minor or temporary impacts, and 7% had major and temporary or minor and prolonged impacts. Since 1990, when the BMP audit program in Montana began, the effectiveness and application rate of BMPs has increased steadily (Mathieus 1996). However, in view of the most recent audit results (Mathieus 1996), it is unreasonable to assume that all sediment impacts will be eliminated through the use of BMPs. Specific BMPs to be used for the project will be identified in the Plan of Operations. If on-site audits of BMPs identify shortcomings in application or effectiveness of any BMPs, immediate corrections will be made and mitigations employed as necessary.

The change in Rock Creek sediment loading attributable to the project was estimated using the Forest Service model R1-WATSED. This model predicted that annual sediment yield in the entire Rock Creek watershed during the initial stages of the project would be 65 percent greater than existing conditions. At the end of the life of the mine, annual sediment yield is predicted to return to existing conditions.

Any sediment that reached Cabinet Gorge Reservoir would likely settle out rapidly. Impacts to habitat in Cabinet Gorge Reservoir from sediment are expected to be insignificant. However, to the limited degree that migratory bull trout are present in Rock Creek, reduced spawning success in Rock Creek could affect fish populations in Cabinet Gorge Reservoir (see Fish section below).

Deposited sediment impacts to aquatics/fisheries in Rock Creek from Alternative II would be potentially significant if deposited sediments were not flushed. Impacts from suspended sediments on aquatics/fisheries under Alternative II would also be potentially significant in the short term and nonsignificant in the long term.

Metals. The Clark Fork River would receive treated mine adit wastewater. The resulting metals loading is described in Hydrology. Metals levels would remain below Montana cold-water aquatic life standards. Impacts to aquatic life under Alternative II from metals loading into the Clark Fork River and Lake Pend Oreille would be negligible. In the unlikely event of a tailings slurry pipeline rupture, impacts to Rock Creek from metals loading could be significant, and are discussed earlier under Spills and Impoundment Failure.

Water Temperature. Clearing within riparian areas for construction of the road/utility corridors, four stream crossings, borrow areas, and catchment basins would expose small areas of the stream channel to direct sunlight, possibly increasing water temperatures and plant growth in those areas. The rise in temperature and related impacts would likely be localized in the aquatic community. Impacts from temperature increases under Alternative II would primarily affect fish in the short term (see Fish below) and cannot be quantified in the long term.

Nutrients. Discharge of treated mine water would result in minor increases of nitrogen to the Clark Fork River. Resulting changes in water quality would be difficult to measure because the nitrogen load would be minor and a large volume of water in the Clark Fork River would be available for dilution (see **Hydrology**).

After reclamation was complete, the concentration of nitrates and other nitrogen compounds would return to near baseline conditions (see **Hydrology**). Limited impacts from nutrients to aquatic life in the Clark Fork River and Lake Pend Oreille are anticipated.

Nitrogen loading to Rock Creek below the proposed evaluation adit waste rock dump, mill site, and mine waste rock dump could temporarily increase during construction (see **Hydrology**). The impact of this loading on aquatic plant communities cannot be quantified; however, the impact would be greatest and potentially significant in the short term (probably 1 to 5 years).

Aquatic invertebrate populations would respond to changes in the alga community. Aquatic invertebrates may increase in number, species diversity may decrease, and species composition may change. Species that are tolerant of organic pollution, such as excess nitrates, may replace sensitive species. The degree of change would depend on the amount of nutrients and the duration of elevated levels. Impacts to macroinvertebrates from increased nutrients under Alternative II are expected to be significant in the short term.

However, both the public and the agencies have expressed concerns as to the reliability of the proposed passive biotreatment technology and the use of an ion exchange system for nitrate removal. The proposed passive biotreatment technology has not been used extensively in mine waste water treatment, especially, under prolonged low temperature conditions as are anticipated at the Rock Creek site. There are also concerns about complexity and reliability of the proposed ion exchange system.

Stream Habitat Alteration. There would be some direct disturbance of stream habitat of Rock Creek during mine facility construction. Construction of bridges, utility corridors, and pipeline crossings would involve heavy equipment operating in and adjacent to the stream channel, resulting in disturbance to the stream substrate and banks. ASARCO's commitment to use BMPs, and the mitigations required under a 310 permit, would minimize these impacts. Habitat impacts to Rock Creek under Alternative II would be moderate in the short term and negligible in the long term.

Two unnamed tributaries to the West Fork Rock Creek would be routed around the proposed mill site in lined canals (see **Waters of the U.S. and Wetlands**). The conversion of these streams into ditches would result in a reduction of diversity and abundance of aquatic life currently inhabiting these streams. No baseline biological data are available on the upstream tributary (fed by spring SP-3). Aquatic macroinvertebrate sampling at site WRC-4 had the overall highest abundance of macroinvertebrates of any sampling site in the Rock Creek drainage. No data on fisheries are available for either tributary. Degradation of the two unnamed tributaries should have a negligible impact on the diversity and abundance of aquatic life in the Rock Creek drainage as a whole. Mitigation for the loss of these streams during the construction/operation period would consist of constructing 1.5 acres of Waters of the U.S. in this area during reclamation (see **Waters of the U.S. and Wetlands**).

The culvert extension on the West Fork Rock Creek has the potential to be a barrier to fish passage if installed incorrectly. Reviews during the permitting process should ensure that fish passage is maintained at this location.

Wilderness Lake Water Levels. Impacts to wilderness lakes are unlikely (see **Geology** and **Hydrology**). However, it should be noted that if a subsidence-related reduction in surface water levels did occur, the impact to aquatic resources would be significant and possibly irreversible.

Aquatic Invertebrates

The proposed project has the potential to reduce the abundance and diversity of aquatic invertebrates in Rock Creek and the Clark Fork River. Impacts from the project may produce conditions that favor species that are tolerant of sedimentation, nutrient enrichment, and/or metals. In Rock Creek, the primary threats are sediment increases (primarily during project construction), direct loss of habitat (during construction and operation in unnamed tributaries to the West Fork Rock Creek), nutrient increases (primarily during construction), and spills of toxic materials (primarily during operation). Impacts to aquatic invertebrates would be limited but somewhat greater in the short term than in the long term.

Fish

The proposed project has the potential to reduce the abundance and diversity of fish in Rock Creek. The primary threats are sediment and nutrient increases (during project construction), spills (primarily during operation), and temperature increases.

Rock Creek is unusual in that several sections of the stream still possess a native fish species complex (westslope cutthroat and bull trout)[2]. Both species of native trout (bull and westslope cutthroat) are sensitive to habitat degradation. Brook trout (a non-native species) are generally considered to be more tolerant of sediment and increases in temperatures than are the two native species. Habitat degradation could result in non-native species gaining a competitive advantage over native species. Habitat degradation from the project may be sufficient to cause the loss of the resident bull trout and westslope cutthroat trout in Rock Creek.

Brook trout interbreed with bull trout and their offspring are sterile. It is generally believed that such a mating is detrimental to bull trout populations (Leary, Allendorf, and Knudsen 1983). Therefore, habitat degradation may give brook trout a competitive advantage over bull trout. If this occurred, a significant loss of native species and biodiversity in Rock Creek would result.

Adfluvial (fish that migrate from lakes to streams to spawn) bull trout populations in the Cabinet Gorge Reservoir/lower Clark Fork River ecosystem are low and are at a very high risk of elimination (Thomas 1992). Pratt and Huston (1993) characterized this population as stable but fragile. Bull trout populations in Cabinet Gorge Reservoir are supported by two tributaries: Bull River and Rock Creek. The available data suggest that adfluvial bull trout in Rock Creek are very rare compared to the Bull River population (WWP 1996). The small number of nursery streams increases the probability that the population would be unable to recover from catastrophic events. In addition, the bull trout population is low enough to put genetic diversity in jeopardy. Given the precarious state of the fish in this system, the loss of Rock Creek as a spawning and rearing tributary could push the bull trout further towards elimination in this drainage.

Human population changes and improved recreational access in the area (see **Socioeconomics**) would increase the number of recreationists and anglers near Rock Creek and the Clark Fork area near Noxon. The increased numbers of anglers would primarily focus on Noxon and Cabinet Gorge reservoirs (see **Recreation**). Therefore, adverse impacts to fish in Rock Creek from increased fishing pressure are expected to be negligible.

The Forest Service has developed guidelines for evaluating potential impacts to inland native fish (INFISH) (USFS 1995). Alternative II complies with INFISH standards and guidelines except where noted below. Standard TM-1b refers to application of silvicultural (timber harvest) practices in a manner that does not retard attainment of Riparian Management Objectives (RMOs) and that avoids adverse effects on inland

[2]A proposal to list the Columbia River population segment of bull trout as a threatened species was published in the federal register on June 13, 1997. This proposal, along with information used to support it, was incorporated into the Biological Assessment (see **Appendix B**).

native fish. As indicated above in the temperature subsection, timber harvest within the riparian zone could result in localized increases in temperature. One of the RMOs specified in INFISH specifies that there would be no measurable increase in water temperature. Water temperature would be periodically monitored during mine construction and operation (see **Appendix H**).

Standard MM-2 specifies that adverse impacts to riparian zones and fish from the construction of roads and facilities should be avoided. As noted above in the sediment subsection, it is likely that some sediment would be deposited in Rock Creek from construction activities within the riparian zone. Because sediment fines are already relatively high in Rock Creek spawning gravels, increased sediment loading could adversely affect inland native fish. Specific mitigations proposed as part of the road construction design could satisfy the overall goals and objectives of INFISH even if this specific standard was not met.

Impacts to fish under Alternative II could be substantial and significant.

Alternatives III and IV

Readers should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Aquatic Habitat

Spill and Tailings Paste Facility Failure. Moving the mill site to the confluence location would result in a shorter slurry pipeline. The headwaters of the West Fork Rock Creek would no longer be at risk from a spill. Impacts to the West Fork Rock Creek from spills would be negligible under Alternative V.

Leak detection equipment and double-walled pipelines for tailings slurry and concentrate should reduce the likelihood that a spill would occur or go unnoticed (see **Hydrology**). Despite the reduced likelihood, potential impacts to aquatic habitat from spills and accidents under Alternative V would be potentially significant depending on the same variables discussed for Alternative II.

Risk of a paste facility failure would be greatly reduced because of the reduced mobility of the tailings paste (see **Geotechnical Engineering**). Impacts to aquatics/fisheries in Rock Creek and the Clark Fork River from an impoundment failure could be limited and potentially significant in both the short and long term depending on seasonal, locational, and operational variables.

Sediment. This alternative should result in a reduction of sediment reaching Rock Creek. Eliminating the proposed mine portal access road (Alternative II) would minimize or eliminate slumping potential, in turn reducing sediment impacts to aquatic resources in Rock Creek. Overall impacts from bridge replacement and construction would be reduced (see **Transportation**). The new location of FDR No. 150

would be farther away from Rock Creek on a bench with more stable soils, minimizing impacts to the stream. Restricting the extent of road construction or reconstruction along Rock Creek would minimize the amount of unreclaimed and ungraveled surface subject to erosion. Locating the tailings slurry line along FDR No. 150 could reduce associated disturbed acres. Under Alternative V, the length of the utility corridor would be shorter. In addition, a 300-foot buffer between the mill site and the East and West Fork Rock Creek would further reduce the quantity of sediment that actually reached Rock Creek. A sediment abatement effort on 114 acres of Rock Creek and/or Bull River watersheds under Alternative V would offset expected short-term sediment effects.

Construction-phase BMP audits, followed by corrective measures, would help reduce new sediment impacts. In addition, a sediment source identification and mitigation program is proposed on NFS lands in Rock Creek and Bull River drainages. This program should reduce the existing sediment sources in the drainage and reduce the impacts of new sediment sources on Cabinet Gorge bull trout. The disturbed acreage would be at least 30 percent less than any other alternative. The change in Rock Creek sediment loading and composition attributable to Alternative V was estimated using the Forest Service model R1-WATSED. This model predicted that annual sediment yield in the entire Rock Creek watershed during the initial stages of the project would be 30 percent greater than existing conditions. Although Alternative V contains a requirement for implementing a sediment source identification and reduction plan, the lack of specific mitigation meant that the effects of this mitigation could not be quantified and incorporated into the WATSED model. It is anticipated that implementation of sediment source mitigations in the Rock Creek watershed would reduce the amount of sediment generated during mine operation and further reduce post-mining sediment yields (Steve Wegner, KNF, pers. comm. with Kathleen Johnson, DEQ, September 12, 1997). At the end of the life of the mine, annual sediment yield is predicted to be 20 percent lower than existing conditions.

It is clear that the amounts of suspended sediment would be potentially less in the long term under this alternative. However, since very little spawning habitat is available, and available gravel in mainstem Rock Creek already contains a high level of fine sediment, any short-term increase in the percentage of deposited fine sediment in these spawning substrates would further reduce survival to emergence and potentially contribute to elimination of resident fish populations. To the limited extent that migratory bull trout are present in Rock Creek, reduction in spawning success in Rock Creek could also impact fish populations in Cabinet Gorge Reservoir. Therefore, impacts from sediment to Rock Creek would be minor but potentially significant under Alternative V.

Water Temperature. Less disturbance would be required along the utility/pipeline corridor, resulting in fewer impacts to the aquatic resources as a result of riparian zone disturbance. One fewer detour bridge would be required, reducing the disturbance to streamside vegetation. Impacts from increased water temperature under Alternative V would be negligible.

Nutrients. Discharge of treated mine water would result in minor increases of nitrogen to the Clark Fork River. The proposed dual nitrate removal system, consisting of anoxic biotreatment and reverse osmosis, appears to be capable of reliably removing dissolved nitrate from the mine waste water. The proposed anoxic treatment system has been demonstrated to be effective at removing nitrate from similar mine waste water under Montana climatic conditions. Reverse osmosis is a proven technology for removing dissolved solids, including nitrate, from water under conditions and at flow rates similar to that anticipated at the Rock Creek mine. The outfall and diffuser proposed under Alternative V would result in effluent dilution

across the entire width of the river (see **Hydrology**). Limited impacts from nutrients to aquatic life in the Clark Fork River and Lake Pend Oreille are anticipated.

Stream Habitat Alteration. By moving the mill site to the confluence area, direct habitat impacts to the West Fork Rock Creek and its unnamed tributaries would be reduced or eliminated. There would be some direct disturbance of stream habitat of Rock Creek during mine facility construction. The joining of pipelines and utilities within the same corridor would reduce the impacts to stream habitat compared to Alternative II. BMPs applied during construction and the mitigations required under a 310 permit would further minimize these impacts. There would be some limited impacts to stream habitat in Rock Creek under Alternative V in the short term.

Wilderness Lake Water Levels. Increasing the level of rock mechanics analysis and mine plan reviews to reduce the risk of subsidence would also reduce the risk that wilderness lakes would be affected by the mine. Therefore, impacts to wilderness lake water levels under Alternative V would be unlikely. If lake levels were reduced as a result of mining activities, a contingency plan would be implemented to curtail the flow to underground workings and to mitigate impacts to wetlands and aquatic life. If a reduction in wilderness lake water levels did occur under Alternative V, the impact would be significant and possibly irreversible.

Aquatic Invertebrates

Under Alternative V, the potential for erosion, sedimentation, and spills would be reduced by mitigations and modifications to the project. Impacts to aquatic invertebrates in the unnamed tributaries of the West Fork Rock Creek would be eliminated by moving the mill site to the confluence of the West and East forks. Short-term impacts to aquatic invertebrates are expected to be minor.

Fish

Since the upper reaches of West Fork Rock Creek support apparently self-sustaining populations of resident bull and westslope cutthroat trout, it would be less detrimental to those fisheries resources to locate the mill site and mine portal downstream. Fish populations in the headwater portions of the West Fork Rock Creek would remain relatively undisturbed. Impacts to bull and westslope cutthroat trout in Rock Creek would be further reduced under this alternative by establishing a 300-foot buffer zone around the confluence mill site.

Alternative V complies with INFISH standards and guidelines except where noted below. Standard MM-2 specifies that adverse impacts to riparian zones and fish from the construction of roads and facilities should be avoided. It is likely that some sediment would be deposited in mainstem Rock Creek from construction activities within the riparian zone. Because sediment fines are already relatively high in Rock Creek spawning gravels, increased short-term sediment loading could adversely affect inland native fish. Specific mitgations proposed as part of the road construction design could satisfy the overall goals and objectives of INFISH even if this specific standard was not met.

Impacts to fish in the West Fork Rock Creek under Alternative V would be limited. Despite mitigation measures, impacts to fish in mainstem Rock Creek would be less than under Alternative II but greater than under the no-action alternative. Impacts to fish populations would be assessed during periodic monitoring throughout the life of the project (see **Appendix H**).

Cumulative Impacts

Forest Service timber sales and any logging on private lands in the Rock Creek drainage concurrent with mining could have an effect on the timing and magnitude of runoff events, thereby increasing sediment, erosion, and channel instability. Logging activities in the Bull River drainage have the potential to impact the migratory bull trout in Cabinet Gorge Reservoir. Current and planned Forest Service timber sales in the drainage include the Lost Girl and Berray Mountain sales. The Lost Girl timber sale is located high in the watershed and buffer strips around water bodies will be relatively wide. Sediment impacts, if any, to the Bull River drainage from this sale should be minor (T. Nygaard, U.S. Forest Service, Cabinet Ranger District, Montana, December 2, 1997). The Berray Mountain sale will be helicopter logged. Road reconstruction will total less than one mile. A collapsing bridge over the Bull River will be removed in conjunction with this sale which should reduce the imminent risks to the Bull River posed by the wash out of the footings of this bridge. Overall sediment impacts from this sale should be a net reduction in sediment loading to the Bull River (ibid.).

The Forest Service is currently working on a watershed rehabilitation program in the Dry Creek drainage to reduce erosion, remove old roads, and eliminate washed out road crossings. During the initial phase of the project, conducted in 1994, approximately 10 miles of roads were removed (T.J. Kline, U.S. Forest Service, Cabinet Ranger District, pers. comm. with Tad Deshler, December 2, 1997). Reassessment of the area should occur in 1999. This program should result in a net decrease in sediment loading to the Bull River drainage.

ASARCO is logging a portion of their land along the Bull River and in the Rock Creek drainage, adjacent to mainstem Rock Creek. Potential impacts of logging could include reduced channel stability, increased sediment in the stream substrate, elevated water temperatures, and changes in the magnitude and timing of peak runoff events. The degree of impact will depend on the logging prescription, width of buffer strips, and the implementation and effectiveness of BMPs.

The proposed project and other concurrent activities could jeopardize the continued existence of adfluvial bull trout in Rock Creek by increasing sediment loads during construction or in the event of a severe mine-related accident. The fishery management goal of Montana Fish, Wildlife & Parks in Cabinet Gorge and its tributaries is to enhance bull trout populations (Montana Fish, Wildlife & Parks 1997). Population viability can be best increased, if successful, by passing adfluvial bull trout to and from Lake Pend Oreille and the Cabinet Gorge system, including Rock Creek. Adfluvial bull trout are an important component of bull trout populations within the Cabinet Gorge system because of their migratory nature. A specific proposal has not been put forth, so it is impossible to accurately predict the impacts of a fish passage facility. The facility could potentially improve the status of bull trout by reversing the trend of habitat fragmentation initiated by the construction of the dams. Loss of the adfluvial bull trout component, or their habitat, in Rock

Creek would decrease the likelihood of successful restoration or maintenance of bull trout in the Cabinet Gorge.

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

Summary

The proposed project could have a significant effect on components of biodiversity under all action alternatives except Alternative V. The proposed project could result in a decline of project area plant and animal species diversity and numbers, although mitigation and design features would reduce project area impacts from moderate to minor levels under Alternative V. These are potentially long-term effects.

Potential adverse effects result from mine-related impacts such as increases in disturbance; direct loss of habitat or a decline of habitat effectiveness; and increases in mortality risks. It would be the combination of indirect and cumulative impacts that would cause the most detrimental effects to most animal species.

The analysis of sensitive animal species in the draft EIS was based on limited information. Additional studies were completed or started after the draft EIS. Greater information will be available for the final EIS. Based on the information available at the time of the draft EIS, it was determined that alternatives II, III and IV could cause potentially significant impacts to four Forest Service sensitive species (harlequin duck, fisher, lynx, and wolverine) and/or their habitats, two management indicator species (pileated woodpecker and mountain goat), and old growth habitat. Impacts to three sensitive species (fisher, lynx, and wolverine) have been determined to be much lower than expected at the time of the draft EIS under alternatives II through IV and would be further reduced under Alternative V, based on forest-wide habitat and viability analyses. Impacts to harlequin duck would be the potentially most serious of the effects to wildlife other than federally-listed threatened or endangered species. Impacts to harlequin ducks would be substantially reduced by Alternative V mitigations. All these species would be affected to some degree by loss, alteration, and degradation of habitat, and increased human disturbance and activities.

Other wildlife species in general could be displaced, restricted in use of habitat and travel corridors, and suffer higher stress and mortality levels. A decline in animal numbers could result.

The proposed project would affect habitat by physical alteration or destruction, fragmentation, and decreasing effectiveness or usability. The loss and degradation of old growth habitat, under all action alternatives except Alternative V, would result in a decline in abundance and occurrence of various old growth associated species in Compartment 711.

Up to 11 populations of plant species of special concern would be partially or totally destroyed under the action alternatives if they cannot be avoided. If KNF sensitive plant species cannot be avoided,

study, conservation, or mitigation would be required under the National Forest Management Act. Alternative II would impact the fewest populations of plant species of special concern. A reduction of plant community diversity on reclaimed sites compared with similar undisturbed lands would result. In addition, the proposed project would result in an increased rate of noxious weed spread over current conditions.

Alternative I would have the least impact on biodiversity, including wildlife and vegetation resources except for impacts resulting from the potential sale of ASARCO lands and subsequent change in land use. Alternatives II to IV would likely have significant short- and long-term adverse impacts for many aspects of biodiversity. Alternative V would likely have significant to less than significant short- and long-term adverse impacts.

Introduction

Aspects of biodiversity that are discussed in this section include plant species of special concern, noxious weeds, wildlife habitat/vegetation communities, old growth forests, and wildlife species including Forest Service sensitive wildlife species and management indicator species. Other sections that tie closely to this discussion are Wetlands and Waters of the U.S., and Threatened and Endangered Species. Between the draft EIS and this supplement, several major additions to the information base for sensitive plant and wildlife species were obtained. The draft EIS assumed a "worst-case analysis" based on limited available habitat and species population information. Changes in old growth acreages resulted when calculations were generated from a GIS (geographical information system) database rather than from manual measurements on maps. The following accounts are modified from the draft EIS based on the new information, where the new information indicates the analysis would be substantially different from that in the draft EIS. Because of the amount of new information and the resulting changes in impact analysis, the discussion of environmental consequences for all five alternatives is included in this section.

Alternative I

Wildlife Habitat/Vegetation

Plant Species of Special Concern. The populations of Black snake-root, Slender wintergreen and Yerba Buena have been impacted to an unknown degree in the study area because ASARCO logged their private lands in the proposed impoundment area since the baseline studies were completed. Future disturbance impacts to other plant species of special concern are difficult to predict under Alternative I. Site-specific activities are unknown and surveys continue as time and budgets permit. Activities on KNF lands would have surveys completed. Private land surveys are not required unless a permit is required such as a mining or water quality permit. No other major disturbances have occurred since the baseline studies were conducted in the area.

Noxious Weeds. Noxious weeds would continue to spread in the area in spite of the limited control efforts being applied by federal, state, county, municipal and private land managers. This is true in all parts

of Montana, not just in the proposed project area. Noxious weeds could eventually reach the CMW area through spread by the limited human users of the area.

Wildlife Habitat/Vegetation Communities. Wildlife habitat and vegetation communities would continue to change due to logging activities, human developments, fire and natural succession. Forest fragmentation would increase or decrease with logging and natural succession of logged areas. Human caused habitat impacts are expected to rise as human population and demands increase, although at a slower rate than would occur with the action alternatives. Wildlife would be affected to varying degrees by the expected changes in habitat.

ASARCO has indicated they probably would not maintain their property ownership in Rock Creek if the project was not approved (ASARCO 1997c). If their acreages (886 acres) were sold, significant changes could occur to wildlife habitat within the drainage (see **Socioeconomics**). The upper elevation lands probably would not change in habitat value from current unless land use changes significantly. The lower elevation lands have gentle topography with relatively easy access to the highway, so it would be reasonable to expect that they would either continue to be managed for timber management or sold and developed as homesites. This is particularly important because more than half of Rock Creek from the highway to the confluence of the East and West forks (2.4 miles of 4.7 miles total) is currently owned by ASARCO.

Loss of wildlife habitat would occur if the lands currently managed for timber harvesting or awaiting minerals development would be sold for homesites or shorter term timber values. An increase in fragmentation of wildlife habitat would occur because of the conversion of habitat to houses. This type of fragmentation is more impactive to forest-adapted wildlife than is timber harvesting for several reasons (see **Wildlife Species** below). It would be a permanent loss of habitat to houses, outbuildings, and low diversity pastures.

If ASARCO did choose to maintain their holdings in the Rock Creek drainage, timber management on their lands would be expected and perhaps accelerated, based on past activities. This would reduce cover along Rock Creek and possibly affect the water quality. Because of the proximity of their lower elevation lands to Rock Creek, some degree of impacts to harlequin ducks and other riparian-associated species could be expected.

Effective Old Growth Habitat. Forest Service management of old growth as Management Area (MA) 13 is discussed in the Forest Plan section.

Old growth habitat on NFS lands, because it currently is designated under MA 13, would remain primarily undisturbed. Existing amounts of MA 13 old growth (7.4 percent) would remain below the recommended minimum until other forest stands (such as replacement old growth) grew into old growth habitat.

Table 4-19 displays acreage of effective old growth and effective replacement old growth affected by each alternative. Effective old growth habitat would remain at the current level of 867 acres of 1,032 acres total old growth (6.2 percent) because of the effects of existing roads and the small size of some blocks.

Under current conditions, the long-term maintenance of old growth dependent species would be difficult under Alternative I.

Wildlife Species

Wildlife Species in General. Human-caused wildlife disturbance and habitat impacts are expected to rise as human population and demands increase, although at a slower rate than would occur with the action alternatives. Mortality risks likely would increase as human presence and use of the area increases.

Forest Service Sensitive Wildlife Species. The occurrence of breeding harlequin ducks on Rock Creek likely would continue but would remain vulnerable if land uses remain similar to current uses. The stability of the lower Clark Fork subpopulation of harlequin ducks would remain tenuous due to low duck populations, habitat loss, and mortality risks. Modest changes in land uses along any of the streams currently used may have significant consequences to the subpopulation.

If ASARCO were to sell its lands, and land use changed from current uses, several important changes have the potential to occur. The most important possible change would be in the use of land from timberlands to homesite development. This would be particularly significant for the sensitive species most at risk, harlequin duck, for the following reasons. The location of FDR No. 150B, currently adjacent to the creek in an important area for harlequins, would probably remain in its location without the large economic incentive for the change in location and subsequent closure that Alternative V proposes. The configuration of ASARCO's lands places them along the riparian areas, along the most important portions of stream for harlequin ducks (as well as fisher). An increase in homesites would likely be accompanied by some aspects of development incompatible with nesting or rearing of ducklings, including continuous close proximity of people, livestock or carnivorous pets. Clearing of land near the stream, either for homesites, pastures or timber harvesting, would remove the sight buffer from the road and could lead to increased disturbance. An increase in homesites would increase the amount of traffic on the road from current levels, although this increase would be a small to moderate fraction of the increase proposed under any action alternative.

Other species affected if the ASARCO lands converted to homesites would be those noted under indirect effects of increased human development in the Lower Clark Fork and Bull River valleys.

The long-term viability of the fisher, lynx, wolverine, and harlequin duck are directly and indirectly dependent on the extent of the impacts from human population increase in the region. Many of the most serious adverse impacts are due to increased human presence. The no action alternative allows a much longer period of time between the existing human population condition and a human population increase similar in size to that predicted as a result of mine-related growth. This time period may allow for the development of solutions to some of the factors working against long-term viability, including

TABLE 4-19

Comparison of Alternative Effects of Effective Old Growth Habitat in Compartment 711

Effective Old Growth Component	Alternative				
	I	II	III	IV	V
Effective Old Growth (OG):					
Change in Acres of Effective OG (difference from existing)		-122	-47	-30	+1
Direct Loss	0	-28	-17	-11	0
Ineffective	0	-94	-30	-19	+1
Remaining Effective OG Acreage*	867	745	820	837	868
Percent Effective OG in Comp. 711**	6.2	5.3	5.9	6.0	6.2
Replacement Old Growth (ROG):					
Change in Acres of ROG (difference from existing)		-5	-3	+6	+6
Direct Loss	0	-2	-2	0	0
Ineffective	0	-3	-1	+6	+6
Remaining Effective ROG Acreage*	644	639	641	644	644
Percent Effective ROG in Comp. 711**	4.6	4.6	4.6	4.6	4.6

Source: Kootenai National Forest GIS database 1997b

Note: 1032 = Total MA acres of OG

650 = Total MA acres of ROG

14,029 = Total acres in Rock Creek Compartment 711.

There is a difference in the method of calculating direct acres affected between Forest Plan and this table. In the Forest Plan, roads are considered as part of the old growth acres and for this effective acreage table, the acres encumbered by roads is subtracted.

* 165 acres of MA 13 (1032-867 = 165) are considered currently ineffective habitat due to road corridors, small size of stands (less than 25 acres), or fragmentation.

** Percent effective old growth = acres of effective old growth/ acres in compartment

habitat loss, highway mortality, incidental trapping or hunting mortality, and disturbance from pet dogs and snowmobiles.

Forest Service Management Indicator Species. Increased use by mountain goats of the Rock Creek area may be expected if goats are displaced by the Montanore project. Elk and other wildlife security could improve as open road densities are reduced to meet Forest Plan compliance. The downward trend of amphibian abundance and occurrence is expected to continue.

Other Species of Interest. Current land uses would not be expected to affect most of the species in this group substantially differently than in most other similar drainages.

If ASARCO were to sell its lands for homesite development, several important impacts could occur to groups of species in this section. Homesites and associated features such as livestock and domestic animals generally support species not adapted to forest habitat. Such species as starlings, house sparrows, pigeons, and brown-headed cowbirds each can be directly or indirectly impactive to native species. Starlings are aggressive cavity-nesters that outcompete native species for nesting sites, affecting tree swallows and others. Pigeons are implicated in the deaths of northern goshawks from a communicable disease transmitted during ingestion (Beebe 1974, p.62). Brown-headed cowbirds are aggressive and prolific brood parasites (birds which lay their eggs in others' nests) and are implicated in a number of species' declines. Brown-headed cowbirds are strongly associated with agricultural sites, which can be as small as a corral with waste grain, and would be expected to increase substantially over existing levels if new homesites were built in the lower elevations of Rock Creek. Their presence could then be expected to reduce the diversity and numbers of several species of open-cup nesting songbirds. This is particularly important for willow flycatchers, a species recorded in the vicinity during the baseline study (Farmer and Heath 1987).

Alternative II

Wildlife Habitat/Vegetation

Plant Species of Special Concern. Under Alternative II, 9 of 16 populations of plant species of special concern (four different species) identified in the permit would be destroyed. Suitable habitat for all five species identified in the study area would also be lost or affected.

Construction of the tailings impoundment would destroy the rest of one population of both black snake-root, slender wintergreen, and much of the relatively extensive Yerba buena population over the levels of disturbance noted for Alternative I. Construction and/or reconstruction of the roads, slurry pipeline and power line corridor along Rock Creek would destroy the know populations of fringecup, pointed broom sedge and possibly wavy moonworts. If wavy moonworts could not be avoided, study, conservation, or mitigation would be required under the National Forest Management Act. Crested shield fern (a.k.a. Buckler fern) populations that were thought to be in the area were misidentified and would not be affected by the proposed project. Impacts to plant species of special concern would be important in the short term under Alternative II.

More information would be needed about the distribution of each species to determine long term impacts to species viability. A conservation easement for the crested shield fern which was identified in the draft EIS would not be required for the final EIS because the plant thought to be crested shield fern was misidentified.

Noxious Weeds. Noxious weeds are spreading across Montana. On areas proposed for disturbance, such as this project, the goal is to keep weeds in check during operations such that the rate of spread is comparable to the rate of spread on adjacent undisturbed lands. The disturbed soil created by construction activities would provide favorable sites for several noxious weed species. The spread of weeds is unavoidable and can only be limited by aggressive weed control activities. Noxious weed seed would likely be spread by vehicles moving from infested areas to newly disturbed areas and along roads and utility corridors. Potential introduction and spread of weeds from the evaluation adit site and increased traffic on the Chicago Peak Road increases the likelihood of noxious weed introduction into the CMW over Alternative I.

ASARCO has committed to developing an effective weed control plan in cooperation with the Sanders County Weed Board and the Agencies. Implementation of the revegetation plan and early detection of new infestations and treatment would be key elements of ASARCO's weed monitoring and control program. Any necessary herbicide applications, biological control agent releases, mechanical controls or other aspects of the integrated weed control program would be made in accordance with approved materials and methods under the supervision of licensed applicators as required by law. An effective weed control program would minimize weed infestations on lands disturbed by the proposed disturbances.

Wildlife Habitat/Vegetative Communities. Direct impacts from Alternative II of the proposed project would occur to wildlife habitat by physical alteration. Indirect impacts would be a decrease in habitat effectiveness (usability) from disturbance or fragmentation. New habitat for species that prefer openings would be created.

A total of 584 acres of wildlife habitat would be degraded, lost or altered under Alternative II including about 293 acres of forested habitat, 273 acres of riparian habitat, 8 acres of wetlands, and 10 acres of subalpine habitat. Impacts to water resources are described in **Aquatics/Fisheries** and **Hydrology**. Habitat that is altered or destroyed can have a short- or long-term effect. Long-term habitat loss outside of the project area due to mine-related home building and recreational demands would also occur.

Some additional wildlife habitat would become less effective because of mine related noises and activities, increased road traffic and increased human presence. The acreage affected varies with species and types and durations of disturbances. The greatest reduction of habitat effectiveness would occur during mine construction. Disturbance caused by traffic would occur throughout mine life. A portion of this less effective habitat would likely return to usable habitat upon closure of the mine and completion of reclamation.

Usable habitat would be fragmented by construction of mine facilities. Habitat may be bisected by roads or isolated from other similar habitat. The proposed project would fragment old growth and riparian habitat, travel corridors, and other important habitat. The significance of fragmentation from road building is

variable depending on wildlife species or ecological community. However, in general, increased fragmentation would be undesirable for key wildlife and biological communities on KNF.

The proposed project would eliminate forested cover along the utility corridors. This change from forested to open grass/shrub communities would provide additional habitat for those species preferring open areas (such as juncos and bluebirds).

The revegetation plan proposed by ASARCO would result in extensive areas seeded to grass and forb cover during the life of the operation. These areas would likely be attractive foraging areas for some species such as big game and bear. Overall plant community diversity for sites directly impacted would be reduced in the short term and succession would be slow due to changes in soil materials and vegetation species established (see **Soils and Reclamation**).

Effective Old Growth Habitat. Alternative II would result in the direct loss of 28 acres of effective old growth habitat, (see **Table 4-19**). Effectiveness of the remaining old growth would decrease by 94 acres due to increased fragmentation and edge effect. Effectiveness of travel and dispersal corridors along Rock Creek and the West Fork Rock Creek would be severely reduced due to the presence of the mine facility and roads. If loss of effectiveness is considered, the percentage of old growth habitat in Compartment 711 would decline to 5.3 percent, well below the recommended 8 to 10 percent needed to support old growth dependent species. Loss of effective old growth habitat would decrease abundance and diversity of old growth associated species and lead to a decline in biodiversity in Compartment 711 for the short-term and possibly long-term. Impacts to effective old growth habitat under Alternative II would be significant.

Wildlife Species

Wildlife Species in General. Alternative II would negatively impact wildlife by displacement; by restriction in use of habitat and travel corridors; by increased disturbance and mortality; and direct habitat loss.

Mine-related noises and activities, increased road traffic, and increased human presence would cause some wildlife to leave the area. Displaced animals could suffer reduced vigor due to the stress associated with being displaced or if the animals were displaced into less suitable habitat. Where unoccupied suitable replacement habitat was not available, eventual mortality could occur. Most wildlife populations are habitat-limited. Thus, mortality is the typical fate of displaced animals because they are at a competitive disadvantage with individuals already occupying suitable habitat.

Rock Creek is a travel corridor for numerous species. The mill site, increased road widths, new utility corridors, and increased traffic levels would decrease effectiveness of Rock Creek drainage as a travel corridor and could inhibit movement.

The proposed project would result in a higher occurrence of wildlife-vehicular collisions. Under the proposed project, FDR No. 150 would be paved and upgraded. Traffic would increase up to about 1,440 percent on FDR No. 150 and 38 percent on Montana Highway 200 (see **Transportation**).

Several key indirect impacts to wildlife would occur. The most significant effect on all wildlife species as a whole is the increase in human developments as a result of mine-related employment. The loss of wildlife habitat effectiveness in the Bull River and Lower Clark Fork valleys as housing increases, commercial establishments grow, access roads increase, and pets, especially dogs, roam, will amount to far more than the direct loss of habitat within the project area. Increased hunting pressure, poaching and disturbance to wildlife would result from the increased access and human population associated with the proposed project. More hunters and recreationists would be able to access areas currently difficult to reach because FDR No. 150 would be upgraded and maintained for year-round use (see **Recreation**). As a result, more human activity would occur during all seasons. This human-caused disturbance could decrease wildlife health and vitality, which may decrease reproduction. Wintering animals would be especially sensitive to increased human presence.

The amount of any illegal taking of wildlife is difficult to determine and predict. Recent mine-related poaching occurrences in Libby provide some insight into potential problems. In 1990, a total of 14 separate charges were brought against five subcontractors of Noranda Mineral Company for poaching 11 big game animals on the Montanore project site (Al Bratkovich pers. comm. with Lisa Fairman 1992). While measures would be taken to reduce poaching potential, some poaching would inevitably occur.

Impacts to wildlife species in general under Alternative II could be significant for some species.

Forest Service Sensitive Wildlife Species. Alternative II would impact six sensitive species. Of these, the harlequin duck would be the most directly and significantly affected. Alternative II would have minor to less than significant effects on five sensitive species: wolverine, fisher, lynx, boreal owl and Coeur d'Alene salamander. The remaining sensitive species flammulated owl, black-backed woodpecker, Townsend's big-eared bat, northern bog lemming) would not be affected.

The draft EIS determined that harlequin duck, fisher, lynx, wolverine, Townsend's big-eared bats, and black-backed woodpeckers would be significantly to slightly affected by Alternative II; new information is included below in the species accounts. Potential effects on the boreal and flammulated owls could not be determined at the writing of the draft EIS. These two species have been included in the supplemental in the individual species account below.

Forest Service sensitive species generally would be affected by the proposed project in a similar manner as previously described in Wildlife Species in General.

Harlequin Duck. Harlequin ducks, especially breeding females, avoid areas with human activities (Reel, Schassberger, and Ruediger 1989). Increased mine-related noise levels and activity, such as the greatly increased traffic along FDR No. 150, and increase of human use on Rock Creek likely would create intolerable levels of disturbance for the harlequin duck. Noise studies completed by ASARCO after publication of the draft EIS indicate that noise from a single large ore truck passing along the road, even attempting to make noise for study purposes, is not likely to be heard above ambient stream noise in vegetated areas (ASARCO Incorporated 1996). The majority of the noise disturbance pertinent to harlequins

would be from the portion of FDR No. 150B where the road is very close to the creek in sections 27 and 28. The creek is visible from FDR No. 150B at several locations, which would be a visual disturbance even if noise was minimally heard. This area has been shown by monitoring to be key harlequin duck breeding habitat, so the greatest disturbance for this species would be in their most important habitat.

Disturbance from mine-related activity could result in harlequin ducks abandoning Rock Creek as a breeding area. The ducks may not successfully relocate or be displaced to adjacent streams because of their strong fidelity to traditional areas. Indeed, only one incidence of long-distance (ie 50 km) movement of a female from her natal stream has been documented; this occurred on one of the drainages used by the Lower Clark Fork subpopulation with a hen banded near Lake Pend Oreille, Idaho (Reichel 1997).

Some harlequin habitat near or in the riparian zone could be altered or destroyed. Short-term reduction of water quality would occur during construction. Should this affect aquatic insect populations (see **Aquatics/Fisheries**), the main food base for harlequins could be reduced for short durations.

Although the probability of a spill of hazardous materials or pipeline rupture is remote, it has the potential to be extremely damaging to harlequin ducks. ASARCO has developed a spill plan (Hydrometrics 1997) to manage the risk of this occurrence. Harlequin ducks would be affected by some types of hazardous materials more than others. These would be any that affected the long-term productivity of Rock Creek, or short-term toxicity during the breeding season. There are four risk factors to consider for harlequins: 1) the risk that a spill would contain either of the hazardous materials types noted above, 2) the risk of a spill entering Rock Creek, 3) the risk that it would be during the time of year that harlequins are present (approximately April through August) or that the effect would remain through that period, and 4) the risk that cleanup procedures would be ineffective. The joint probability of these occurring is extremely remote.

Should one of these spills occur, a loss of at least one breeding season's productivity or possibly the adult females may occur. Loss of the adult breeding females would be significant primarily because of the site fidelity noted above. If stream productivity was not compromised for more than one breeding season, or only the young were affected, the loss may depress the Lower Clark Fork subpopulation in a similar way as a normal non-productive breeding season. It is unknown how many poor production years the Lower Clark Fork subpopulation can tolerate and remain viable, but it is not likely to be many because of the low numbers. Combined with the disturbance factors, the Rock Creek breeders would probably experience significant loss of vigor. The proximity of FDR No. 150B would increase the probability of a spill of hazardous materials affecting harlequin ducks.

Disturbance and the subsequent loss of some effective harlequin habitat along Rock Creek would last for 35 years (from mine construction through operation and reclamation). While effective harlequin habitat may occur after mine-related disturbances end, harlequins probably would not return to or recolonize Rock Creek without extraordinary measures to reintroduce them. This is because the knowledge of Rock Creek as a breeding area would end with the last successful brood of harlequins raised in Rock Creek and colonization of unoccupied streams is likely a rare event (Reichel and Genter 1995).

The indirect effect of increased human population around the Lower Clark Fork and Bull River valleys is likely to affect the continued viability of harlequins as well. Streams that presently support nesting or foraging harlequins may become more desirable for human development. Similar disturbances on any drainage supporting harlequins are likely to have the same effect as disturbance on Rock Creek, particularly if the disturbance is permanent as in the case of homesite development.

Loss of one of the four breeding areas and the associated decline in recruitment of harlequin ducks could be significant to the lower Clark Fork subpopulation. This would result in the decline and possible elimination of this subpopulation. The loss of the Lower Clark Fork subpopulation would be considered a reduction in range, thus trending the species towards federal listing under the Endangered Species Act (J.Reichel, F.Cassirer, R.Jarvis, pers. comm. Dec. 7, 1996). Impacts to harlequin ducks under Alternative II could be significant.

Fisher. Alternative II would result in a loss of fisher habitat and would increase mortality risks. This could result in a decline of population numbers.

The proposed project would result in a loss of fisher habitat through physical destruction, fragmentation, and a decrease in effectiveness. Loss and degradation of key habitat such as old growth forests, riparian areas, and travel corridors would occur. Habitat reduction would occur for both the short and long terms. Some riparian habitat in the drainage would be effectively lost, and wetlands mitigation for Alternative II would itself destroy some fisher habitat at Borrow Area 3. New analysis indicates that fisher habitat is currently disjunct along Rock Creek, and that a concentration of habitat occurs to the west of the permit area boundary. The direct habitat loss of 28 acres of old growth, by itself, is probably insufficient to significantly reduce fisher numbers in the Rock Creek drainage. This is because it is not the only habitat fishers use, although it is disproportionately important for the habitat components it provides. The numbers of fishers present in the Cabinet Mountains are probably not limited by habitat, based on the amount of habitat available (Johnsen 1997). Suitable fisher habitat in Compartment 711 will increase over time as the large number of younger stands age, such as those managed for replacement old growth.

Rock Creek would likely become a less effective or an ineffective travel corridor because of the increased traffic on FDR No. 150 and direct reduction of fisher habitat. This would reduce movement between drainages to the east and west around the CMW. Reducing fisher movement between drainages is undesirable (Heinemeyer and Jones 1994) and counter-productive to recovery efforts in the Cabinet Mountains. The increase of traffic along FDR No. 150 would primarily affect fisher movement around the base of the CMW, because most of the CMW is too high elevation to provide suitable habitat. The higher elevations tend to be devoid of the continuous mature and older forest fishers prefer, and the CMW is a barrier to east and west travel. As fisher attempt to travel to other suitable habitat, FDR No. 150 could be a barrier because of disturbance and risk of mortality. Alternative II reduces some riparian habitat useful for travel as well as foraging and denning.

The proposed project might increase mortality risk due to slightly increased direct or incidental trapping from mine-related increased local human population (see **Recreation**). Because the fisher population is small, loss of individuals could be significant

Fishers have demonstrated tolerance to moderate degrees of human activity (Heinemeyer and Jones 1994); however, Alternative II would cause high levels of human activity. As a result, fishers could be displaced out of Rock Creek drainage and/or suffer high stress levels that could result in reduced reproductive success.

If fishers were to be displaced from the Rock Creek drainage, they would probably re-establish after mine closure because suitable habitat is widespread around the Rock Creek vicinity and adequate fisher habitat would remain in the drainage. However, low fisher population levels would decrease the opportunity for this re-establishment to occur in the short term. Disturbance would substantially decrease after mine closure, but habitat loss, primarily old growth, would remain over the short term. This habitat loss would be replaced within several decades because the majority of the compartment is either mature or immature sawtimber which will grow into mature and older stands (barring a stand-replacing wildfire).

The indirect effects of the project would cause increased habitat loss for fishers because of the increase in human populations in the Lower Clark Fork and Bull River valleys. Fisher tend to occur in lower elevation, gentle gradient habitat near water, which is desirable for human homesites as well. While fisher may tolerate human activity to some degree, dogs and snowmobile activity associated with otherwise good habitat may reduce population levels.

Alternative II would reduce fisher habitat, increase human disturbance, and increase mortality risks. Alternative II may impact individual fishers, but would not trend the species towards federal listing under the Endangered Species Act.

Lynx. Alternative II would be the most impactive of the action alternatives for lynx, because it has the most activity in the higher elevations lynx prefer. Direct impacts to lynx from Alternative II would be from habitat loss at the evaluation adit, and disturbance at the mill site and mine portal. Indirect impacts would be from possible increased mortality from trapping, and from increased traffic in lower elevation travel corridors.

The direct habitat lost from Alternative II would be denning habitat (3 acres) and travel habitat (7 acres) at the evaluation adit, and any foraging habitat rendered less usable due to disturbance from the road to the evaluation adit. Denning habitat at the evaluation adit would remain unusable for an indefinite period after the construction phase. However, because lynx can use small areas of suitable denning habitat if adequate foraging habitat is present, this loss is not likely to be damaging to lynx populations. After the evaluation adit construction phase, the reduction in use of Chicago Peak Road would probably be adequate to allow use of the area during lynx foraging time periods, and also because of the proximity of the CMW with its larger areas of foraging habitat. At the time of this writing, Kootenai National Forest Lynx Habitat Unit guidelines have not been developed for the Cabinet Ranger District and could not be used for analysis.

Mortality risks would increase due to increased human use and accessibility to habitat. Mortality from additional trapping or poaching likely would be low, primarily because the likelihood of lynx occurring in the area is low. However, because lynx are highly susceptible to trapping and populations are very low, loss of individuals could be significant. Any lynx lost in trapping mortality would probably be transient

individuals rather than residents, based on the low availability of habitat to support a resident population. Montana Dept. of Fish, Wildlife and Parks has the responsibility of ensuring trapping mortality does not exceed levels injurious to the population, so trapping regulations could be modified if mortality is excessive.

Another form of indirect mortality is from highway mortality. Traffic levels on Montana Highway 200 are expected to increase as a result of mine operation. The Kootenai National Forest has identified a lynx travel corridor at the narrowest crossing of the Clark Fork River near Noxon (KNF Lynx Conservation Strategy, 1997). This area would be where much of the traffic increase would be along the highway, so roadkills of lynx are possible. This impact is of concern primarily from a genetic interchange perspective, and has a very low likelihood of occurrence because of the very few individuals potentially involved. After mine closure, trapping and mortality risks would decrease but could remain higher than pre-mine levels, because some of the increase in human population would remain in the Lower Clark Fork Valley.

Direct impacts to the lynx under Alternative II would be minor, based on lack of suitable habitat within the Lynx Habitat Unit. Indirect impacts would be greater but not potentially significant, with highway mortality being a low risk but the most long-term and uncontrollable impact. Alternative II is not likely to adversely impact lynx or their habitat.

Wolverine. Alternative II is one of the most impactive of the action alternatives to wolverine. Impacts from Alternative II would be from disturbance at the millsite, an increase in disturbance in the CMW, and the increase of human development in the Lower Clark Fork and Bull River valleys causing a loss of remote habitat. Mortality risks from incidental trapping and increased human development would increase due to increased human use and accessibility to habitat.

Most wolverine habitat in Compartment 711 is higher elevation than the area disturbed by the project. Direct habitat loss would only occur at the evaluation adit (maximum of 10 acres). Wolverines are habitat generalists and this quantity of habitat loss is minor. Wolverines are highly mobile, and have occurred in the project area at times in lower elevations, as well as many other areas. These individuals are likely to be transient wolverines. Transient wolverines may be disrupted in travel because of Alternative II mine activities; the two features primarily affecting wolverine travel are activity at the millsite because it is close to wolverine habitat, and the increased number of vehicles on FDR No. 150. A higher risk of highway mortality may occur with FDR No. 150 at these times. Over a broader area, the increased human development in the Bull River and Lower Clark Fork valleys may cause a more important impediment to travel. Human development is hazardous to wolverines because of the mortality risk associated with dogs, snowmobiles, and increased traffic.

Wolverines are very prone to disturbance during the denning period (Copeland 1996, p.2). Denning habitat in Idaho was in high snowy cirque basins, similar to many locations in the CMW. Disturbance is most impactive in late winter and early spring. Disturbance is unlikely to increase during the denning season in the CMW because of the inaccessibility of suitable denning habitat. Disturbance from recreationists at other seasons in the CMW may increase, and the effect of increased non-motorized disturbance is unknown. Wolverines occur in areas, such as Glacier National Park, that have a much higher human presence than is expected in the CMW. The response of Glacier's wolverines, or other animals, should be viewed carefully when compared to the CMW because wolverines are not exposed to trapping or the potential for shooting as

they are in the CMW. After mine closure, disturbance would substantially decrease from mine operation levels.

The increase in human development as a result of the proposed project is likely to result in an increased risk of mortality from trapping losses or illegal shooting. Trapping mortality is under greater management control than illegal shooting, and can be regulated if numbers reach unacceptable figures. Illegal shooting is probably a rare event, but because wolverine numbers are very low, it can be an important contributor to population declines.

Direct impacts to the wolverine under Alternative II would be minor. Indirect impacts could be potentially moderately significant. Together, Alternative II may impact individual wolverines, but it is not likely to trend the species towards federal listing under the Endangered Species Act.

Townsend's Big-eared Bat. Alternative II would destroy 583 acres of potential summer roosting and foraging habitat. Additional similar habitat is present in the area making this loss of habitat less than significant. Winter habitat is not expected to be affected. It is not known how mine-related disturbance would affect bats. Because bat winter habitat would not be affected and loss of summer habitat is considered minimal, the proposed project would not be expected to result in the decline of local bat populations. For bats, this determination was based on the loss of summer foraging and possible tree cavity roosting habitat as a direct result of mine development. These biological components were not considered limiting factors, thus the ability for the species to occur in the project area was not considered limited (Fairman, Hackley, and Thomas 1995). The draft Conservation Strategy (1996) for Townsend's big-eared bats confirms that tree cavities are rarely used, and that they use a wide variety of habitat for foraging, so direct habitat loss would not affect this species. Potential to create wintering habitat for the Townsend's big-eared bat could occur upon closure of the mine if adit closures were designed to accommodate bats. The proposed project would have no impact on Townsend's big-eared bats or their habitat.

Northern Bog Lemming. Bog lemming habitat occurs only in the East Fork Rock Creek drainage at Rock Creek Meadows and would not be affected by the proposed project. There would be little increased mortality risk. The proposed project would have no impact on northern bog lemmings or their habitat.

Black-backed Woodpecker. The proposed project would not affect the preferred habitat of the black-backed woodpecker, so there would be no impact on this species or its habitat.

Coeur d'Alene Salamander. The proposed project would be required to minimize effects to drainages, which represent the majority of suitable habitat for Coeur d'Alene salamanders. Microsites along FDR No. 150 that may provide limited habitat could potentially be temporarily affected by road reconstruction, although all of the identified suitable habitat is outside of the road prism. This species commonly occurs along roadside ditches and cutbanks with suitable habitat on both the Idaho Panhandle and Kootenai National Forests, so road reconstruction does not necessarily mean complete loss of habitat. Some additional mortality may rarely occur due to increased traffic. The proposed project may impact individuals but would not trend the species towards federal listing under the Endangered Species Act.

Flammulated Owl. None of the action alternatives would affect flammulated owl habitat. Since there is a scarcity of suitable habitat for this species in Compartment 711, it is unlikely that any disturbance effects would occur. Thus, there would be no impact to the flammulated owl from the proposed project.

Boreal Owl. A maximum of 4 acres of marginally suitable boreal owl habitat would be directly impacted at the evaluation adit. Since there is a scarcity of suitable habitat for this species in Compartment 711, it is unlikely that any disturbance effects would occur. It is unlikely that the loss of 4 acres of marginal habitat would be a determining factor in the presence of owls within the compartment and would not measurably impact this species.

Forest Service Management Indicator Species. Four of the eight management indicator species (mountain goat, white-tailed deer, elk, and pileated woodpecker) are discussed below; the others are discussed under **Threatened and Endangered Species**. The four management indicator species would be affected by the proposed project in a similar manner as that previously described in General Impacts to Wildlife. Specifics to indicator species are presented here. Alternative II could have substantial impacts to pileated woodpeckers and mountain goats. As indicators of old growth, snag, or cavity habitat and alpine habitat, respectively, the effects on these species could be used to gauge effects on those habitats.

Mountain Goats. The overall effect of Alternative II could be a decline of the Rock Peak goat herd. The only direct impact of the mine would be a minor habitat loss at the evaluation adit and ventilation adit. Indirect effects would have a much greater impact. Indirect effects include disturbance from mine activities, primarily during the construction phase, that displaces goats from suitable habitat or reduces their ability to effectively use the available habitat. This could decrease reproductive rate and increase mortality. The most important mine-related impact to mountain goats would be a result of increasing human use in the Rock Creek drainage and the CMW. Increased mortality would result from an increase in both poaching and hunting. Because mountain goats have a relatively low reproductive rate, disturbance, and increased mortality from increased poaching could have negative impacts on the goat population.

Direct habitat removal would be minor. Eight acres of mountain goat Situation 1 summer/transitory habitat would be lost, (less than 1 acre at the wilderness ventilation adit and about 7 acres at the evaluation adit site). Development of the mill site and transportation/facilities corridor would result in the destruction of about 14 acres of mountain goat Situation 3 range, most of which is not currently used by goats.

Alternative II of the proposed project would result in the greatest habitat effectiveness loss of the action alternatives. **Table 4-20** portrays impacts to goat habitat from mine-related noise disturbance. During the relatively short period of construction, 495 acres of Situation 1 summer/transition habitat and 393 acres of Situation 3 summer/transition habitat would become less effective because of mine-related disturbance. Joslin (1980) recommended that activities in Situation 1 mountain goat habitat should not occur longer than one year in order to avoid disruption of traditional use patterns. The construction phase is expected to take approximately one year, thus it is at the outer edge of the longest recommended duration for intensive activities. During operation, 29 acres of Situation 1 and 501 acres of Situation 3 habitat would become less effective because of mine-related disturbance. No winter habitat would be affected by mine-related disturbance for any alternative. Goats likely would suffer increased stress levels from disturbance during construction and operation that could result in a decline in reproductive rates.

Increased human population growth attributable to the mine in the Lower Clark Fork and Bull River valleys would result in more disturbances due to increased recreation and increased mortality from hunting and poaching. Disturbance would be facilitated by the proposed improved roading and year-round access. The disturbance would be greatest during the one year evaluation adit construction period when both the FDR No. 150 and 2741 would remain open year around. These indirect effects, which would extend beyond Rock Creek drainage, can have great impact on goat populations (Geist 1975; Joslin 1980; Joslin 1986; Rice and Benson 1984).

Displacement from suitable habitat is one likely result of increased disturbance. It is not known if suitable habitat exists to accommodate displaced goats. The larger historic population numbers of goats implies that at one time suitable habitat existed to support more goats than now exists on the habitat. The reasons for unoccupied habitat today may be the same reasons the proposed project may impact goats, that is, disturbance and increased mortality resulting from an increase in human population.

TABLE 4-20
Alternative Effects on Mountain Goat Habitat

Habitat	Total* Acres	Existing Condition		Alt. II		Alt. III		Alt. IV		Alt. V	
		Eff Ac	% Eff	Eff Ac	% Eff	Eff Ac	% Eff	Eff Ac	% Eff	Eff Ac	% Eff
Summer Transition 1	8,652	7,869	91								
Construction Phase				7,374	85	7,475	86	7,500	87	7,500	87
Acres Affected				1,278		1,177		1,152		1,152	
Change from Existing**				- 495		- 394		- 369		- 369	
Operations Phase				7,840	91	8,075	93	7,960	92	7,960	92
Acres Affected				812		577		692		692	
Change from Existing**				-29		+ 206		+ 91		+ 91	
Summer Transition 3	18,892	12,806	68								
Construction Phase				12,441	66	12,886	68	12,185	64	12,183	64
Acres Affected				6,451		6,006		6,707		6,709	
Change from Existing**				- 393		+ 80		- 621		- 623	
Operations Phase				12,313	65	12,838	68	12,743	67	12,789	68
Acres Affected				6,579		6054		6,149		6,103	
Change from Existing**				- 501		+ 32		- 63		- 17	
Winter 1	669	669	100	No Change		No Change		No Change		No Change	
Winter 2	173	173	100	No Change		No Change		No Change		No Change	
TOTAL ACRES AFFECTED		Construction Phase		- 888		- 314		-990		-992	
		Operations Phase		- 530		+238		+28		+74	

Notes: Construction phase conditions: open roads buffered by 1/4 mile; site points buffered by 1 mile; ventilation adit buffered by 1,200 feet for Alternative II and 100 feet for Alternatives III, IV, and V.

Operations phase conditions: open roads buffered by 1/4 mile; sites buffered by 1/2 mile; ventilation adit buffered by 1,200 feet for Alternative II and 100 feet for Alternatives III, IV, and V.

Ac Acres

Eff Effective/Effectiveness

* Mountain goat analysis area includes Compartments 710, 711, 744.

** A negative change is acres from existing conditions indicates a reduction in the number of effective acres because of project effects; whereas a positive change indicates an addition of effective acres.

After mine closure, recolonization of habitat likely would take a long time. Displacing goats from traditional habitat for 30-to-35-years could result in habitat use information not being passed on to new generations. The long-term effects of displacement could be the loss of goat herd occurrence or abundance in Rock Creek, Copper Lake Basin, and adjacent areas for greater than 35 years unless reintroduction efforts are made. Reintroduction efforts with mountain goats have been successful, particularly if overhunting has ceased (D. Spicer, IDFG, pers. comm. July 29, 1997).

Mortality risks from poaching and legal harvest of goats would probably increase with the greater human accessibility and use of the area. In other goat herds, this has resulted in a marked decline or elimination of goat herds (Foster 1987; Joslin 1986; Phelps, Jamieson and Demarchi 1975). Goats wintering near Rock Creek Meadows would be especially vulnerable to disturbance and increased mortality. Legal harvest of goats is under management control by the Montana Department of Fish, Wildlife and Parks, and could be reduced if goat herd populations indicated a significant decline.

Alternative II could affect the Rock Peak goat herd by direct habitat loss, increased disturbance leading to decreased habitat effectiveness, and increased mortality risks, resulting in a decline in goat numbers.

Elk. The proposed project would result in some elk habitat loss through physical alteration and a decrease in effectiveness. The main elk winter range and the Green Mountain/McKay Creek range would not be directly affected by the proposed project. However, increased mine-related disturbance would reduce habitat effectiveness on several small bull elk wintering areas located near the tailings impoundment, between Miller and Rock Creek, and in scattered areas along Rock Creek. Some elk summer habitat would be made less effective due to increased open road densities, and greater disturbance (see **Table 4-21**). Open road density would be greatest in Alternative II, and higher than recommended (Thomas 1979). Some elk could be displaced out of the vicinity for 35 years.

TABLE 4-21

Open Road Density (Mi./sq.mi.) Projections (MS-1 lands)

With ASARCO Rock Creek Alternative

B.A.A.	Alt. I	Alt. II	Alt. III	Alt. IV	Alt. V
7-4-7 [1]	0.62	0.62	0.62	0.62	0.62
7-5-2 [2]	0.83	0.92	0.82	0.74	0.74
7-5-3	0.00	0.00	0.00	0.00	0.00
7-6-1 [3]	0.77	0.79	0.74	0.74	0.74

ORD standard is 0.75 mi./sq.mile

1 Assumes closure of private roads in section 5 in 1997 (ALL ALTS) and new roads all in MS-3 lands

2 Assumes ASARCO mit. Alt. 2 none; Alts. 3, 4, & 5 (2.06 mi. : 1.88 mi. FDR No. 2741, 0.18 mi. FDR No. 2741x)

3 Assumes ASARCO mit. Alt. 2 none; Alts. 3, 4, & 5 (1.61 mi. FDR No. 2285)

The proposed project would increase elk mortality risk due to increased traffic and human access and use. Poaching frequency and hunting likely would increase.

White-tailed deer. Direct effects as a result of the proposed project would include physical loss of habitat, displacement, and loss of individuals from the population. The proposed project would increase mortality risk from increased traffic, human use and access, and poaching. The anticipated increases in mortality and habitat loss would not affect white-tailed populations.

Pileated Woodpecker. Alternative II would have a potentially significant effect on the local population of pileated woodpeckers because the relatively low amount of existing old growth in the compartment indicates a marginal amount of habitat is currently present. Fewer acres of old growth would decrease the available effective habitat for this species. This loss of 122 acres of effective old growth may reduce the local habitat threshold for Compartment 711 such that pileated woodpeckers may have a difficult time finding adequate foraging or nesting trees within a spatial area compatible with efficient metabolic requirements. Proportionately, the loss of these acres is small. Pileated woodpeckers are known to commonly forage and successfully reproduce in the compartment (Farmer and Heath, 1987), so the habitat quality is implied to be quite good, if not abundant. This suggests that factors, such as annual weather patterns or wildfire, may have a greater effect on, or conversely may additively affect, the viability of the local population.

Impacts to the pileated woodpecker under Alternative II would be potentially the most significant of the action alternatives.

Other Species of Interest. Other species of interest could be affected by the proposed project in a manner similar to that described under Wildlife Species in General. Effects to some species are described below.

Black Bears. Black bears would be affected by the proposed project by direct habitat loss, disturbance, and an increase in mortality risk. Alternative II would alter or destroy 583 acres of black bear habitat. Additional habitat would be rendered less effective, in approximately the same manner as for grizzly bear (see **Threatened and Endangered Species**). Black bears respond to road influences less than grizzly bears in spring, and about the same as grizzly bears in fall (Kasworm and Manley, 1994), so the use of the grizzly bear Cumulative Effects Model displacement guidelines provides a conservative approach to loss of habitat effectiveness (pers. comm. L. Fairman, July 29, 1997). Habitat lost or rendered ineffective includes key areas such as riparian areas and travel corridors. The proposed project would increase mortality risk from increased traffic, human use and access, hunting, and poaching.

Mule Deer. The proposed project would cause a general loss of mule deer habitat. Critical habitat such as winter ranges would not be affected.

Moose. Moose habitat loss would most prominently occur in the slurry pipeline and road corridor along Rock Creek. Noise and activity disturbance could displace moose out of the area. It is unknown how this could affect the local population.

Mountain Lion. Fluctuations in big game populations affect mountain lions because of their dependence on a prey base such as deer. The proposed project could cause a displacement of some local big game populations and a related mountain lion displacement. If deer are displaced into areas occupied by humans (such as housing development) or if mine-related home building occurred in areas with concentrations of big game, an increase in human-lion encounters could occur. Mortality risks to mountain lions could result from increased potential for vehicle-lion collisions and increased hunting. Increased mortality is not expected to affect mountain lion populations.

Selected Wildlife Groups.

Furbearers and Small Mammals. Furbearers and small mammals would be affected similar to impacts described under General Impacts to Wildlife and other sections such as Forest Service Sensitive Wildlife Species. Impacts to furbearers and small mammals under Alternative II are variable depending on species.

Birds. A variety of songbirds and neotropical migrants would be affected by habitat loss and mortality. Those species associated with old growth would be the most adversely affected. Fragmentation of forested habitats and the increase in open grass-shrub habitats would result in higher populations of those birds preferring open habitats and loss of individuals preferring forested environments. The indirect effect of building mine-related housing would be to eliminate bird habitat.

Raptors would experience a loss of habitat. Those raptors associated with specialized habitat, such as old growth and riparian zones, would be negatively affected (see **Old Growth**). Potential for raptor mortality by powerline electrocution would be minimized by proposed raptor-proofing (ASARCO, Incorporated 1987-1994).

Two of the four game species found by Farmer and Heath (1987) would be affected by the project. The ruffed grouse and blue grouse would suffer habitat loss and increased mortality. Some ruffed grouse habitat would be eliminated during construction of slurry lines and road widening. Hunting pressure of grouse could increase, resulting in a higher mortality. Hunting seasons and bag limits are set by the state, and if declines are high enough to affect population levels, hunting mortality can be adjusted to compensate.

Amphibians and Reptiles. The species in this group most affected by the action alternatives are those associated with the riparian areas, either for breeding or for their entire life cycles. Of these four species (long-toed salamander, Pacific tree frog, tailed frog, boreal toad), the tailed frog is most narrowly tied to riparian areas while the others can breed in small wetlands over a range of elevations and habitat types.

Loss of habitat within the riparian zones would affect individuals of these species by reducing available breeding habitat. Direct mortality may occur during construction activities. Acid rock drainage

potential does not appear to be a likely potential impact to amphibians from any action alternative (see **Geology**). Acidification is implicated in the global decline of amphibians. Siltation of Rock Creek from Alternatives II and III of the project is likely to cause the greatest impact to tailed frogs because of their feeding habits in clear streams (Nussbaum et al. 1983, page 150). In the worst case scenario, complete extirpation of tailed frogs from the lower reaches of Rock Creek would not be likely to lead to loss of species viability because the species is widespread. However, it would reduce the biodiversity of Rock Creek.

Species that would be affected by a general loss of habitat would be long-toed salamander, boreal toad, Pacific tree frog, western skink, racer, rubber boa and the two species of garter snakes. All of these species are widespread with generalized habitat requirements.

Species not affected by the project would be bull frog, leopard frog, rattlesnake, and painted turtles. Three of these species are associated with the Cabinet Gorge Reservoir rather than the permit area. According to the hydrologic effects analysis, the water quality in the reservoir would not be measurably changed from existing condition. The decline of the leopard frog may be associated with the presence of the introduced bullfrog in the vicinity, since congenerics have been extirpated from similar areas (Nussbaum et al. 1983, p 187).

Alternative III

Impacts to biodiversity under Alternative III would be similar to Alternative II with the following exceptions.

Wildlife Habitat/Vegetation

Plant Species of Special Concern. Under Alternative III, 11 of 16 plant populations identified in the permit area would be eliminated (four different species). One additional Black snake-root population would be lost during construction of FDR No. 1022 Tye. On site verification studies would be performed to precisely locate KNF sensitive plant populations for avoidance during preliminary designs. KNF would develop mitigation requirements in the Biological Evaluation being prepared for the project.

Impacts to plant species of special concern under Alternative III would be greatest in the short term unless known populations could be avoided. If avoidance is not possible more information would be needed to determine long term impacts.

Noxious Weeds. Impacts are similar to Alternative II, except under Alternative III, fewer acres would be disturbed and revegetation efforts would be improved which would reduce the spread of weeds in affected areas. Risk of increased weed introduction into the CMW would be likely.

Wildlife Habitat/Vegetative Communities. A total of 609 acres would be disturbed under Alternative III which is 24 acres more than Alternative II. Less riparian habitat would be physically lost

because pipelines would remain on the east side of Rock Creek until the crossing of FDR No. 150 near Engle Creek. A similar amount of riparian habitat would be rendered ineffective due to noise and activity.

Revegetation plan changes detailed in the draft EIS would help meet the Agencies goal for reclamation success, wildlife habitat, and scenic resources (see Chapter 4, Soils and Reclamation and Appendix H of the draft EIS). These changes would result in less acreage being in grass and forb cover during the operation of the mine. Less acreage would be highly attractive to species such as big game and bears. Community diversity and successional relationships would be more closely maintained since a wider variety of trees and shrubs would be planted and native grass and forbs would be seeded. Plant succession would begin earlier.

Effective Old Growth Habitat. Alternative III would result in the direct loss of 17 acres of old growth habitat, and an additional loss of effectiveness of 30 acres. The percentage of effective old growth in Compartment 711 would decline to 5.9 percent. While less old growth would be lost under Alternative III, the same type of effects would occur as described under Alternative II. Impacts to effective old growth habitat under Alternative III would be significant.

Wildlife Species

Wildlife Species in General. Noise impacts from the wilderness adit would be reduced (see **Sound**).

Animal-vehicle collisions could be reduced by eliminating the use of road salt and by daily removal of road-killed animals (thus removing scavenging opportunities).

Forest Service Sensitive Wildlife Species.

Fisher. Alternative III would reduce the amount of old growth habitat directly lost to 17 acres. Alternative III may impact individuals, but is unlikely to trend the species towards federal listing.

Lynx. Alternative III would reduce a minor source of disturbance due to the relocation of the ventilation shaft in the CMW. This change does not affect the determination that effects to the lynx would be minor, and that Alternative III would be unlikely to adversely impact lynx or its habitat.

Forest Service Management Indicator Species.

Mountain Goats. Reducing fan noise of the ventilation adit in the wilderness would reduce the loss of effectiveness of Situation 1 habitat. The configuration of the millsite under Alternative III (i.e., the noise produced by the millsite would overlap the noise produced by the road) would result in the smallest loss of effectiveness of Situation 1 and Situation 3 habitat during construction. A loss of 394 acres of Situation 1, the most important habitat, is offset somewhat by an increase in effectiveness of Situation 3 habitat by 80

acres. During operation, road closures increase effectiveness over existing conditions by 206 acres in Situation 1 and 32 acres in Situation 3. Other indirect effects described in Alternative II remain.

Pileated Woodpecker. Impacts to pileated woodpeckers would be similar to Alternative II although less old growth habitat would be lost (17 acres). The impacts to pileated woodpeckers under Alternative III would be potentially significant.

Alternative IV

Impacts to biodiversity under Alternative IV would be the same as under Alternative III with the following exceptions. Probably the largest difference in impacts result from the change in millsite location to lower down the drainage. This change reduces the amount of FDR No. 150 that would support greatly increased traffic. Acreage disturbed would be lower than the acreage in Alternatives II and III, with a roughly proportional reduction of impact for several species.

Wildlife Habitat/Vegetation

Plant Species of Special Concern. Under Alternative IV, 11 of 16 plant populations identified in the permit area would be lost. Construction of the alternate mill site would destroy one population of slender wintergreen and may destroy part of the pointed broom sedge population. Any impacts to KNF sensitive plant species would require study, conservation, or mitigation.

Noxious Weeds. Under Alternative IV, the mill site relocation would result in 542 acres of disturbance (**Table 2-2**). This is 42 and 66 acres less disturbance than Alternatives II and III respectively. This reduction in acreage would somewhat limit the spread of noxious weeds. The elimination of traffic to the upper mill site could help limit the introduction of weeks into the CMW.

Wildlife Habitat/Vegetative Communities. The alternative mill site would shift some mill site-related effects (such as habitat loss and noise) from the upper West Fork Rock Creek to an area near the confluence of the East and West forks of Rock Creek.

Effective Old Growth Habitat. Alternative IV would result in the direct loss of 11 acres of old growth habitat, and an additional loss of effectiveness of 19 acres. The percentage of effective old growth habitat in Rock Creek Compartment would decline to 6.0 percent. Impacts to old growth habitat under Alternative IV would be moderate.

Wildlife Species

Forest Service Sensitive Wildlife Species

Harlequin Duck. The 300-foot buffer at the millsite may reduce disturbance to harlequin ducks, although this reach of stream is not the most key habitat along Rock Creek. Impacts would remain similar to those described for Alternatives II and III. Alternative IV would be likely to impact individuals and trend the species towards federal listing under the Endangered Species Act.

Fisher. The loss of less old growth than under Alternatives II and III would result in less impact to this species. The move of the millsite to lower in the drainage reduces the disturbance to suitable travel corridors between Rock Creek and the north. Buffers at the millsite reduce disturbance to the travel corridor along the creek. The indirect effect of increased human population, specifically the increase in trapping mortality risk and loss of habitat in the Lower Clark Fork and Bull River valleys, would remain the most important impact. Alternative IV may impact individuals but would not trend the species towards federal listing under the Endangered Species Act.

Lynx. The move of the millsite to lower in the drainage would reduce the likelihood of disturbance to dispersing lynx. Alternative IV would not impact lynx or its habitat.

Forest Service Management Indicator Species.

Mountain Goats. The confluence mill site would be further from summer habitat in the Chicago Peak area. Under Alternative IV, 369 acres of Situation 1 and approximately 621 acres of Situation 3 summer habitat would be affected from mine-related disturbance during the construction phase. During mine operation, proposed closures on FDR No. 2741 would result in an increased habitat effectiveness of 91 acres of Situation 1 from current levels. The proposed closure would decrease mortality risk as well. Alternative IV would result in reduced effectiveness on 63 acres of Situation 3 habitat. Other impacts described in Alternative II would remain for Alternative IV.

Elk. The proposed closure of FDR nos. 2741 and 2285 would reduce open road densities, reducing disturbance to elk.

Pileated Woodpecker. The loss of less old growth than in Alternatives II and III would result in less significant impact to this species. However, the loss still results in an amount of old growth less than minimum Forest Plan standards, which means the threshold for continuation of a local population in Rock Creek may be reached.

Alternative V

Impacts to biodiversity under Alternative V would be the same as Alternative IV with the following exceptions. The largest change would be due to the busing of employees, piping of the concentrate and closing of FDR No. 150B.

Wildlife Habitat/Vegetation

Plant Species of Special Concern. Impacts to plant species of special concern would be essentially the same as described under Alternatives II through IV. Under Alternative V, 11 of 16 populations of plant species of special concern (four different species) identified in the permit would be potentially destroyed. Any impacts to KNF sensitive plant species would require study, conservation, or mitigation

No populations of Crested shield fern (a.k.a. Bucker fern) would be impacted in any alternatives as it was misidentified in baseline studies from the site and does not exist in the area.

Because of the reduction in disturbance acreage in Alternative V over the other action alternatives, as summarized in **Table 2-2**, the chances of avoidance of several populations is increased. Suitable habitat for all five species of special concern identified in the study area would be destroyed. Impacts to plant species of special concern would be greatest in the short term under Alternative V.

Noxious Weeds. Impacts from noxious weeds are similar to Alternative II, except under Alternative V fewer acres would be disturbed and revegetation efforts would be improved. The reduction of mine-related traffic would also reduce the transport of weed seed to the mine. These features would reduce the spread of weeds in affected areas. Impacts from noxious weeds under Alternative V would be limited in the short term.

Wildlife Habitat/Vegetation Communities. Under Alternative V, 480 acres (Table 2-1) of wildlife habitat would be physically altered compared with 584 acres in Alternative II. The lower amount of direct habitat loss from Alternative V than for the other action alternatives is a good measure of overall effect, especially when combined with the reduced effect of decreased traffic on FDR No. 150, closure of FDR nos. 150B and 2741, and decreased loss of old growth. Some riparian habitat loss would continue to reduce the amount and value of this vegetative community important to many species of wildlife. Fragmentation is reduced with Alternative V over the other action alternatives, particularly with respect to old growth, and in the effect of a busy travelway (FDR No. 150).

Effective Old Growth Habitat. The direct loss of old growth habitat in Alternative V of less than 1 acre along FDR No. 150 would minimize the loss of effective old growth; the portion of old growth removed is already marginally effective. The loss of effective old growth occurs when the size or shape of a stand of old growth can no longer function as old growth. Many of the old growth stands in Compartment 711 are currently in this situation. Alternative V does not significantly alter the existing condition. The reduction of traffic along FDR No. 150B increases the effectiveness of the old growth parcel along lower Rock Creek compared with alternatives II through IV. Closure of a short spur road under Alternative V accounts for the additional acreage of effective old growth.

Wildlife Species

Wildlife Species in General. The effects from Alternative V varies, but generally would be similar to the effect of Alternative IV. Direct habitat loss is least with Alternative V, thus impacts associated with direct habitat loss would be the least of the action alternatives. Disturbance and traffic mortality would be decreased from Alternative IV, and would be the least of the action alternatives. Mitigation proposed for

grizzly bear and harlequin ducks would benefit many species. Alternative V is not expected to affect the long-term viability of any of the species in this group.

Forest Service Sensitive Wildlife Species

Harlequin Duck. Alternative V has several features designed to avoid effects of disturbance on harlequin ducks. Disturbance can occur in several forms, including noise, sight, and presence of humans or dogs. The location of disturbance is important as well.

As noted for Alternative II, the presence of increased traffic on the lowest reaches of Rock Creek along FDR No. 150B is in a very sensitive location because of the close proximity of the creek to the road. Alternative V reduces this disturbance to less than existing levels by a considerable amount. The reduction of traffic along this stretch is also important because it is the portion of the road, along with the upper bridge, that road noise would be most likely to cause disturbance to harlequins. The sound disturbance from buses is probably reduced from that of ore trucks, particularly with the required mufflers. The reduction of disturbance along this stretch of road is the single most important factor in avoiding impacts to harlequin ducks from the proposed project. Other design features avoiding impact along this section are the timing restrictions on construction of the pipeline across lower Rock Creek and hauling of waste rock to the paste facility site, vegetation and topographic screening at the paste facility, and relocation of the support facilities site within the paste facility footprint and busing of evaluation construction workers from this lower location.

Disturbance to harlequins would be possible from activities at the tailings paste facility. Vegetative and topographic screening would reduce the impact of this activity both in sight and sound. A limited operating season on activities at the paste facility in line of sight of the creek would reduce the possibility of disturbance from this area. The location of the construction activities on the paste facility would eventually reach a point where activity is not visible from the creek. At this point, no disturbance would be expected regardless of screening or activity periods.

The busing of mineworkers would reduce the effects of disturbance compared to the other action alternatives in several ways. It would funnel people away from FDR No. 150B, and lower Rock Creek, to a parking area where access to the creek is not easily accomplished. It would reduce traffic disturbance along FDR No. 150 and the upper bridge. It would avoid the possibility of some workers stopping along FDR No. 150 for easier access to the creek. Busing of workers would reduce traffic disturbance to a level near what some other harlequin duck populations have successfully tolerated (Cassirer et al., pers. comm. Dec 7, 1997).

While busing mineworkers would reduce impacts relative to the other action alternatives, the paving of FDR No. 150 would still enable an increased number of recreational visitors to access the road and creek. To mitigate the possible disturbance from this group of people, the road would be designed with no-stop zones (except for emergency purposes) with turnouts at locations out of sight of the creek. Additional mitigation items would include vegetation screening for areas of the creek that may become visible from the road from future management actions, and the closure of FDR No. 150B to foot traffic during the breeding season (May 1 to August 1).

A temporary closure during harlequin duck breeding season of the area around the upper bridge is proposed as a measure to reduce possible disturbance from foot traffic and dogs along the creek in this area. The area at the upper bridge is currently a popular huckleberry picking and camping location. Disturbance during the time overlap of the breeding season and huckleberry picking and camping may have contributed to lack of past breeding success in this reach. Another possible explanation is the typical drying of the creek prior to the end of the breeding season in some stretches. If disturbance is the primary cause of unsuccessful breeding in this area, an area closure could encourage harlequins to use the area more than it is currently used. Screening of the traffic on the bridge itself during breeding season is proposed as an experimental measure to decrease visibility of vehicles and reduce the possibility of disturbance from vehicle or foot traffic.

Construction disturbance could occur at some locations of the proposed project. To avoid impacts during the construction phase, a limited operating season would be imposed on those activities that have the potential to disturb nesting harlequin ducks. This includes road and bridge construction/ reconstruction, pipeline and powerline construction, hauling of waste rock from the mine to the paste facility site, and construction at the paste facility and spill contingency pond.

The risk of a hazardous material spill affecting harlequin ducks is discussed in the effects analysis section of Alternative II. For Alternative V, the discussion remains valid except that the probability of a spill reaching Rock Creek, particularly the lower section where the majority of harlequin duck use occurs, is much lower. This would result because of the closure of a portion of FDR No. 150B above the paste facility access road, the section of road both closest to the creek and habitat most important to harlequins. The busing of mine employees and the subsequent reduced number of vehicles reduces the risk of hazardous materials from non-freight vehicles (such as oil and gasoline) from entering Rock Creek. With the presence of a hazardous materials spill plan to rapidly respond to an occurrence, the risk of a hazardous spill adversely affecting harlequin ducks is probably lower than the risk faced by other populations near travelways, such as those along the Lochsa River in Idaho. Nevertheless, if all the risk factors combined in a joint probability of occurrence and a hazardous spill did occur that adversely affected harlequins, their loss would be extremely damaging to the viability of the subpopulation.

Direct toxicity to harlequins from a spill into Rock Creek is an extremely remote risk because of the few occasions when spills would be likely to occur. Less than one trip of hazardous materials (excluding fuel in vehicles) per month would cross any portion of Rock Creek (memo from D. Parker, October 23, 1997), or an average of fewer than 4 trips during the harlequin duck breeding season. The risk of a spill in the creek can be managed by special transportation restrictions during the crossings.

Water quality concerns for harlequins, aside from a spill of hazardous materials or pipeline rupture, is of most concern in terms of direct toxicity or toxicity to their primary invertebrate food source. Project impacts from Alternative V appear to have a low probability of affecting invertebrates over the long term (see **Aquatics/Fisheries**), thus the impact to harlequin ducks from this concern is probably low risk as well. Short term impacts to invertebrates would primarily be a concern to harlequins during breeding season if the depression in numbers was large enough to affect the ability of young harlequins to forage effectively. Since some impacts have the greatest potential to affect invertebrate productivity during the construction phase, and since impacts would be generally of short duration, the breeding season timing restrictions on some construction phase activities would reduce the likelihood of a reduction in invertebrates impacting harlequins.

Changes in surface water flow is an issue for harlequin ducks because Rock Creek has segments that may dry up prior to the end of breeding season. This adversely affects the productivity of this stream because some otherwise suitable reaches are fragmented by dry stretches that ducklings have great difficulty crossing. Thus, any decrease in water flow during the latter portion of the breeding season, or substantial increases in water flow during the peak spring run-off, would adversely affect the ability of Rock Creek to produce young harlequins for the year in which the effect occurred. The effects analysis for Alternative V determined that water flow in Rock Creek would not change to an extent that is likely to adversely impact harlequin ducks.

Indirect effects to harlequin ducks are extremely important because of the very low numbers of breeding pairs in the Lower Clark Fork subpopulation. The indirect effects explored for Alternative II apply to Alternative V as well. The importance of maintaining breeding groups at all four streams in the Lower Clark Fork subpopulation is that each stream can provide a reservoir for individuals to repopulate any of the other streams. The total number of young produced during any given year in the subpopulation is low enough that stochastic events, such as a 100-year storm event could quite readily destroy an entire season's production of young birds. If the Rock Creek breeding harlequins were removed (amounting to approximately 25% of the subpopulation's breeding harlequins), it would affect the ability of the other streams to maintain adequate numbers because it would reduce the buffer of both young produced and experienced breeders. Likewise, if any of the other streams became unable to support breeding harlequins, it would affect not only their ability to contribute to the subpopulation but would also affect their ability to serve as a long-term reservoir in the event that design features and mitigations of Alternative V were unsuccessful at maintaining a short- or long-term breeding presence on Rock Creek. Thus, it is critical that all four breeding streams in the Lower Clark Fork subpopulation be maintained at sufficient habitat quality and quantity to ensure continued breeding at each.

It is possible that the number of individuals currently breeding in the subpopulation is below the minimum necessary to maintain a long-term subpopulation, regardless of any effects of the proposed project. However, because the subpopulation has had stable, if very low, numbers over several years of monitoring (Cassirer et al. 1996), it appears the subpopulation is on the lower edge of viability rather than below minimum, at least for the present.

Assuming that all the above design features and mitigations of Alternative V are implemented, the direct effects of the proposed project would be reduced or mitigated to the extent that Alternative V is not likely to adversely impact harlequin ducks or their habitat, either in the short or long term. If mitigation as described in the Wildlife Mitigation Plan for Alternative V in **Chapter 2** is implemented, the indirect effects of a mine-related increase in human development would be adequately mitigated such that the project may impact individuals but would not be likely to trend the species towards federal listing under the Endangered Species Act. If mitigation is not implemented as described, the indirect effects of Alternative V would be likely to impact individual harlequin ducks and trend the species towards federal listing under the Endangered Species Act.

Fisher. The direct loss of less than 1 acre of old growth in Alternative V would be essentially unmeasurable in its effect on fisher. As with Alternative IV, the loss of other habitat would likely affect fisher somewhat less than the loss of old growth because most of this species' habitat component needs are present in old growth. The loss of some fisher habitat would remain with Alternative V, but as stated for the

other alternatives this amount would not be enough to limit fisher recovery. The reduced amount of total direct habitat loss would have less effect under Alternative V than under the other action alternatives.

The considerable decrease in traffic along FDR No. 150 due to busing of mine employees decreases the risk of mortality from vehicle collisions and decreases the effect of the road as a barrier to fisher movement, particularly if suitable crossings were designed into the road (see Wildlife Mitigation Plan in **Chapter 2**, Alternative V). Reduced traffic along FDR No. 150B would reduce possible disturbance along the riparian corridor. Other mitigation items designed to reduce disturbance to the creek would likely benefit fisher as well.

The indirect effect of increased human population, specifically the increase in trapping mortality risk and loss of habitat in the Lower Clark Fork and Bull River valleys, would remain the most important impact. That portion of this effect directly attributable to the ASARCO Rock Creek mine would likely be mitigated by the land acquisition or easements proposed as mitigation for harlequin ducks and grizzly bears.

With the proposed mitigation, Alternative V may impact individuals but would not trend the fisher towards federal listing under the Endangered Species Act.

Lynx. Busing employees and incorporation of animal-friendly crossings along FDR No. 150 would reduce the mortality risk to any dispersing lynx. Mitigation proposed for grizzly bear would also function as mitigation for the minor direct loss of habitat at the evaluation adit. Alternative V is not likely to adversely impact lynx or its habitat.

Wolverine. Direct habitat loss for wolverines remains a minor amount at the evaluation adit; this amount is not substantial in proportion to the amount of area wolverines normally cover in an average home range. Mitigation for grizzly bear would more than compensate for this loss through an increased security for suitable wolverine habitat.

The lower millsite location of Alternative V combined with a considerably reduced number of vehicle trips for mine employees reduces the risk of disturbance to wolverines in their primary high elevation habitat. If employees are bused to the millsite instead of using their own vehicles, it is possible that the amount of incidental visits to the CMW would be reduced over the number of visits possible otherwise. This may slightly reduce the risk of illegal mortality or disturbance in the wilderness. The greatly reduced number of vehicles reduces the risk of mortality along FDR No. 150 as well.

Alternative V may impact individual wolverines but is not likely to trend the species towards federal listing under the Endangered Species Act. This is because the indirect effects above are largely mitigated for, but not completely, and it is conceivable that a transient wolverine would encounter a fatal situation because of the mine's indirect effects. There is a very low probability of such a situation occurring in the numbers that would trend the wolverine towards federal listing either singly or cumulatively as a result of the proposed project.

Forest Service Management Indicator Species

Mountain Goat. Alternative V would be similar to Alternative IV in its impacts to mountain goats except that 17 acres instead of 63 acres of Situation 3 habitat would be reduced in effectiveness during operations. Neither of these amounts is substantial because of the low quality of affected sites for mountain goat habitat. Direct habitat loss at the evaluation adit remains, and as noted for the other alternatives, a minor loss relative to habitat remaining. Mitigation would reduce the mortality risks associated with increased mine-related human development by providing increased law enforcement and monitoring designed to detect possible herd declines in a timely manner.

Situation 1 summer transitional range is not as limited or as critical as winter range, and the disturbance impact is at the outer edge of both the summer transitional range as well as the outer perimeter of the sound effect from the mine's operations. Thus the disturbance from mine operations may impact the movements of individual goats and decrease the reproductive vigor of those individuals, but the majority of the herd is unlikely to be affected by the sound disturbance. Mountain goats are known to habituate to recurrent noise and may eventually reoccur in the area at some point during the operational phase if disturbance initially displaces individuals.

Situation 3 summer transitional ranges are important to goats primarily by providing travel corridors. Along with the other action alternatives, Alternative V may impact the ability of suitable travel habitat in the Rock Creek drainage to be effectively used for travel because of the greatly increased use along FDR No. 150 over current levels. FDR nos. 150 and 2741 are probably affecting the ability of the drainage to be used for travel at the current level. The impact from Alternative V would be considerably less than for the other action alternatives because of the busing of employees and consequent reduction of number of trips. The majority of the project area used by goats would be in the upper elevations, which would be closed after the exploration phase.

The closure of FDR No. 2741, and the resultant increased security, for the life of the project probably would more than mitigate for the disturbance impact that would occur during the relatively short evaluation adit construction phase of the project. Some shift of areas used by goats in the CMW may occur because the road closure may also shift human recreational use in the CMW; the extent that this shift would adversely affect goats is unknown. That suitable habitat is not currently occupied to carrying capacity is implied by the larger herd size in past decades. If increased recreational use in the CMW was the cause of some of this habitat becoming unsuitable over the past years, then a change in human use patterns may relocate goats to the newly less disturbed areas of the CMW, and may not result in a loss of reproductive vigor.

Increased mortality risk from indirect increases in human use of the CMW and other areas goats occupy would continue to occur in Alternative V. In order to mitigate for this effect, increased law enforcement to reduce the risk of increased illegal mortality on the mountain goat herd would be provided. (See Wildlife Mitigation Plan for Alternative V in **Chapter 2**).

Increased legal harvest as an indirect effect of increased human development has the potential to affect population numbers as well. In order to mitigate this possibility, increased monitoring to determine

population trends would be funded by ASARCO. Projected increased human recreational use of the CMW is another potential impact to goats that would be noted by monitoring. Monitoring would enable the appropriate agencies to determine if management actions, such as implementation of wilderness permit systems, hunting bag limit adjustments, or mountain goat reintroductions, are warranted.

Elk. Alternative V would have the least effect on elk of the action alternatives because of the reduction in open road densities, closure of FDR nos. 2741 and 2285, and reduction of direct habitat loss. The mitigation proposed for grizzly bear would benefit elk, and would substantially mitigate impacts to elk except for the loss of winter range.

White-tailed Deer. Reduced traffic on FDR No. 150 would result in the most important reduction of impact to white-tailed deer because it would reduce traffic mortality.

Pileated Woodpecker. The loss of less than one acre of old growth habitat, representing 0.1% of the current habitat, is probably immeasurable in its effect on pileated woodpeckers. As noted in earlier sections, the amount of old growth in Compartment 711 is already low enough that continued breeding presence of this species is probably marginal. Thus, Alternative V is very similar to the no action alternative in its effect on this species. There may be some increased disturbance from the additional expected traffic associated with the proposed project, which may be partially compensated by the closure of FDR No. 150B. Some of the affected habitat is currently reduced in effectiveness, so this additional possible reduction would probably not be substantial in its effect on this species.

Other Species of Interest. Other species of interest could be affected by the proposed project in a manner similar to that described under Wildlife Species in General. Effects to some species are described below.

Black Bear. The effects of Alternative V on black bear would be similar to, but less than, the effects on grizzly bear (see **Threatened and Endangered Species**). As with other game species, the expected increased legal harvest is under management control and is expected to remain within limits designed to maintain a harvestable population. The effects of increased illegal mortality would be partially compensable because of these legal harvest limit controls, and additional enforcement personnel provided as mitigation by ASARCO should help reduce the number of illegal incidents. The habitat mitigation proposed for grizzly bears would benefit black bears as well. Thus, the effects of Alternative V on black bear would be greater than the no action alternative but the least of the action alternatives.

Mule Deer. Alternative V would have similar effects to the other action alternatives, except that the reduced traffic from busing would reduce the mortality risk associated with increased traffic on FDR No. 150.

Moose. Compared to the other action alternatives, Alternative V would have the least amount of direct habitat loss. The closure of FDR No. 150B would be a benefit over current conditions because the habitat present along lower Rock Creek would have a reduction in disturbance. This benefit might be offset by the general increase in activity for the proposed project in general.

Selected Wildlife Groups.

Furbearers and Small Mammals. The effects to this group of species from Alternative V would vary, but generally would be similar to the effect of Alternative IV. Direct habitat loss is least with Alternative V, thus impacts associated with direct habitat loss to this group would be the least of the action alternatives. Disturbance and traffic mortality would be decreased from Alternative IV, and would be the least of the action alternatives. Mitigation proposed for grizzly bear and harlequin ducks would benefit small mammals. The proposed project is not expected to affect the long-term viability of any of the species in this group.

Birds. Resident and neotropical songbirds would be most affected by habitat loss of old growth, the most limiting of the habitats within the project area (other than wetlands, which are discussed in **Waters of the U.S. and Wetlands**). Alternative V would have the least impact on old growth of the action alternatives, and would be substantially similar to the no action alternative on this group of species. Alternative V would be the least impactive of the action alternatives for direct habitat loss because it has the least amount. Night migrating birds may be at risk for collision mortalities with the millsite because of attraction to lights, but this risk is readily mitigable with appropriate millsite design (see Wildlife Mitigation Plan in **Chapter 2**).

Raptors would be least affected by Alternative V of the action alternatives. The loss of less than 1 acre of old growth is not likely measurable in its effect on raptors associated with older seral stages (such as goshawks). The reduction of disturbance along the lower FDR No. 150B would be a benefit over current conditions, possibly counteracted by the smaller increase in traffic along the remainder of FDR No. 150 between Montana Highway 200 and the confluence mill site compared to alternatives II through IV.

Grouse would not be affected by Alternative V substantially differently than the other action alternatives, except for the lower amount of habitat loss.

Amphibians and Reptiles. A lower amount of direct habitat loss would occur for Alternative V than for the other action alternatives. The magnitude of the effect on this group of species is unknown, however, the mitigation of wetlands is probably the most important factor in the effects of the alternatives. The species most likely adversely affected by the project would be tailed frog, because of its sensitivity to stream sedimentation and specialized dependence on riparian habitat. Alternative V has the least potential for increasing sedimentation of the action alternatives, so it would have the least impact on this species. Although the status of this widespread species is not well understood, the change from existing conditions under Alternative V would be unlikely to affect the species as a whole while still possibly impacting individuals. Alternative V incorporates mitigation for wetlands which would reduce any impact to amphibians as a group.

Reptiles are likely to be less affected than amphibians because their habitat, by and large, is not as restricted as the mesic habitats favored by amphibians. No special habitats are affected by the project that are not widely present elsewhere in the compartment. Alternative V is not expected to affect the viability of any reptile species in the project area.

Cumulative Impacts

Wildlife and Habitat

Cumulative effects are those which are greater when considered together with other impacts than when considered alone. Activities or factors that would have a greater impact to wildlife when considered together than alone are the increased human development beyond normal regional growth, the Montanore mine, timber sales within Compartment 711, the loss of old growth on private and public lands, loss of elk winter range, loss of habitat to mine developments, traffic mortality and travel barriers caused by large active roads. Of these activities, the ones likely to cause irreversible or irretrievable commitment of resources relative to their effects on biodiversity are increased regional growth, the Montanore mine effects, traffic mortality and travel barriers from highways.

The following discussion identifies the species affected by cumulative effects. For species not discussed, cumulative effects would not be greater than the direct or indirect effects disclosed for each alternative. Cumulative effects are similar for Alternatives II, III, IV, and V unless otherwise noted.

Increased regional growth. This is by far the most important cumulative effect because it affects the most number of species and is the most difficult to control. The intermountain west is a growing region, and human population will continue to reduce wildlife habitat in many locations, such as the Bull River Valley, that are now nearly pristine and relatively undeveloped. The effects of the proposed project and other regional activities to increase economic growth are likely to increase the rate of this growth many years before it would normally occur. It is probable that these effects to wildlife would occur at any point the regional human population reaches a certain point, regardless of whether that increase is created by the mine or not. Many species would find it difficult to coexist in locations with noisy houses, carnivorous pets such as cats and dogs (especially allowed to run untethered), and winter snowmobiling. The land used by houses is an irreversible and irretrievable commitment of wildlife habitat resources except in rare cases. Plant species of special concern could be cumulatively affected due to loss of plant populations or suitable habitat from construction of houses, roads, and other human developments. The increase in disturbed lands would also allow for the increased spread of noxious weeds in the region.

Montanore mine. The Montanore mine would have the most direct cumulative effect on mountain goats, because individual goats use areas on both sides of the Cabinet Mountains near the mines. Part of the Rock Peak mountain goat herd uses the head of Libby and Ramsey creeks during the summer, habitat near Rock Creek Meadows in winter, and habitat between these locations. Thirty-five years of disturbance caused by two mines could result in a decline of herd abundance, health and occurrence in some traditional ranges. Wolverine, fisher and lynx would be the other species most likely cumulatively affected by the Montanore mine operation. Lynx and wolverine would be cumulatively affected by a reduction in travel and dispersal capabilities because of a reduction in remote areas and a constriction of the CMW. An increased trapping risk from both mines' increase in local human populations would cumulatively increase the risk that trapping could exceed the ability of the three species to maintain population numbers. Although trapping is under management control, the effects on sensitive species may not be noticed until well after the populations have been suppressed. The construction of both mines would increase the opportunity for noxious weeds to invade the CMW from the east and west. There may be some cumulative loss of habitat for some populations of plant species of special concern.

Timber sales. Although timber sales alter habitat for several wildlife species analyzed in this biodiversity section, fisher is the only species likely to be cumulatively affected by the reasonably forseeable timber sale activity in Compartment 711 (but see loss of old growth section below). Some of the indirect effects of timber sales, such as increased traffic on FDR No. 150, would be insignificant compared to the mine's effects. This cumulative effect would be in the form of loss of current or future suitable habitat. Based on the KNF's forestwide habitat analysis, suitable habitat is probably not limiting fisher. Fishers are slow to recover from extirpated areas even with suitable habitat (Ruggiero et al. 1994). Timber sales within the Rock Creek drainage could cumulatively impact habitats for and populations of plant species of special concern as well as increase the potential for the spread of noxious weeds in the drainage.

Loss of old growth. Alternatives II through IV would directly remove 28 to 11 acres of old growth, respectively. The Montanore project is estimated to disturb approximately 192 acres of protected old growth (MA 13) (U.S. Forest Service et al. 1992). Because the occurrence of old growth habitat is considered to be limited and declining, and is an important habitat component for several sensitive species, the cumulative loss of old growth habitat is an important cumulative effect. Old growth habitat on private lands is at an economic premium and can not be expected to be retained, so the cumulative effect of old growth lost on private and public lands can adversely affect several old growth dependent species, including pileated woodpeckers. This loss can be accumulated if the remnants are too disjunct for recolonization to occur.

Loss of elk winter range. Loss of winter range is occurring throughout the range of elk, through increased human development, increased livestock use, or direct habitat loss. Although several organizations, including the US Forest Service, are attempting to improve winter range in an effort to counteract the trend, the loss is an important population limiter. Cumulatively, the loss of winter range would not affect the species' viability but it may limit hunter opportunities.

Direct habitat loss. The loss of habitat to mine development is cumulatively added to the loss of wildlife habitat throughout the world from other human developments such as parking lots, dams or buildings. There is no unique habitat in Compartment 711 that would indicate any particular species is cumulatively at risk because of the loss of habitat for mine development.

Highway traffic mortality. An overall increase in human population is accompanied by increased highway traffic. The cumulative effect of this increased traffic along with the proposed project's expected traffic increase would be to make highway crossings by wildlife a more hazardous situation. Probably more important would be the inevitable increase in width and standards with highway reconstruction which would facilitate faster auto travel, and thus even fewer safe crossing opportunities. The wildlife species most adversely affected by this would be the rare but wide-ranging ones such as wolverine, lynx and fisher, and the large ungulates.

Highway travel barriers. Increased highway and road widths provide a physical barrier to many species, which decreases their dispersal capability. This affects non-mobile species such as small mammals, reptiles and amphibians. Techniques are being developed to reduce the effect of roads and highways as barriers to wildlife movement, but they are expensive and have not been universally adopted.

THREATENED AND ENDANGERED SPECIES

Summary

There is the potential to increase bald eagle mortality along roads used to access the mine or to haul ore. Increased vehicle traffic would result in more animals killed on the roads. Bald eagles would scavenge on the road kill. Eagles would gorge themselves and be unable to gain elevation rapidly when disturbed by an approaching vehicle. Their flight path would be along the road corridor, thus increasing the likelihood of being struck by vehicles. Mortality risk would also increase indirectly for grizzly bear, gray wolf, and bald eagles due to increases in the number of people in the area and the time people are present.

Migrating peregrine falcons, transient gray wolves, and resident grizzly bear could be displaced, from areas presently or potentially used, by the increased human activity level. With the potential for a large number of people moving into the area to work on the mine, habitat loss for T&E species could occur due to the need to build new residences. The actual number and locations of these homes are not known but they are likely to be along the Clark Fork and Bull Rivers. These areas are classified as Management Situation 3 habitat for grizzly bear (defined in IGBC 1986 pg. 4). Loss of this habitat may affect corridors between larger blocks of suitable habitat (ie. East and West Cabinets) within the Cabinet ecosystem. It could also affect the linkage between the Cabinet and Bitterroot ecosystems, but linkage zone assessments are not complete. The USFWS has initiated a 5 year process to assess the linkage potential between ecosystems. Linkage zones are desirable for recovery, but are not essential for delisting at this time (USFWS 1993 pgs. 24-25).

The areas along the Clark Fork and Bull rivers also provide the best bald eagle nesting, foraging, and wintering habitat. Residences may be built close to active nests, resulting in disruption of nesting activity. They could also be built near feeding or wintering sites, which could displace eagles from traditional use areas.

Spring grizzly bear habitat would be reduced by the physical changes required to operate the mine. Grizzly bear habitat effectiveness would be reduced due to the increase in human activity. Planned Road closures on Federal lands would increase habitat effectiveness for gray wolf and grizzly bear in areas previously open to public use for part or all of the year. The operation of this project reduces the north to south habitat corridor on the west side of the Cabinet Mountains. Constricting this movement corridor could impact a third of the known grizzlies in the CYE.

T&E mitigations would be phased in over the start-up period and be in place by the start up of full operations. Grizzly bear mitigation may not prevent incidental taking, therefore all action alternatives may adversely affect the grizzly bear.

Introduction

Construction and operation of the ASARCO Rock Creek Mine and associated activities would have direct, indirect and cumulative impacts on some wildlife species that are Federally listed as threatened or endangered. Bull trout, a species for which listing has been determined to be warranted but precluded, is addressed in **Aquatics/Fisheries**. Direct impacts result from on site activities that alter habitat; displace individual animals from habitat they normally use; or affect the productivity, survival, or mortality of the species impacted. Indirect impacts result from those activities that occur off site or at a later time, and are not directly a part of the mine operation. Indirect impacts can also affect productivity, survival, and mortality.

The analysis process used for each species discussed is documented in the ASARCO Rock Creek Analysis File, which is available at the Kootenai National Forest Supervisor's Office, and summarized in the Biological Assessment (**Appendix B**). Because there are new numbers generated for original models and new models have been used, descriptions of impacts for all five alternatives have been included.

Effects by Alternative

Alternative I

Bald Eagle. Under the No Action Alternative, bald eagle use along the lower Clark Fork River would continue to increase, as evidenced by the increase in number of nesting pairs found over the past eight years (1988: 0 pairs; 1996: 5 pairs). Mortality risk, due to increased traffic levels, could increase slightly. This is based on average daily traffic (ADT) trends that show a 3.6 percent annual increase over the past ten years and the potential associated increase (4 percent) in deer and elk mortality. Since there is no suitable nesting or winter roosting habitat in the project area, there would be no change in available habitat conditions. Alternative I would have no effect on the bald eagle or its habitat.

Peregrine Falcon. Peregrine falcon use along the Clark Fork River drainage would remain a possibility. The suitable nesting habitat would still be available. The likelihood of a nesting pair moving into the area remains only fair. The use of the area by migrating peregrines could still occur. Alternative I would have no effect on the peregrine falcon or its habitat.

Gray Wolf. Movement of wolves through the project area would still be possible. Since there are no known den or rendezvous sites in the project area and the FDR No. 150 would still be open to public access, there would be no change in the availability of these two components of wolf habitat. Like the bald eagle, a slight increase in mortality risk, associated with increased availability of vehicular killed deer, could occur. The risk to the wolf is low due to very low numbers of wolves in the area. Alternative I would have no effect on the gray wolf or its habitat.

Grizzly Bear. The project area would continue to provide the present amount of spring and fall grizzly habitat. There would be a slight increase in habitat effectiveness (percent of BMU freely available or "uninfluenced"), due to completion of other projects in the BMUs where the Rock Creek Project is proposed. BAA 7-4-7 would retain an open road density (ORD) of 0.72 miles per square mile, until other projects were completed; the ORD would then drop to 0.62 miles per square mile in 1998. BAA 7-5-2 would retain a 0.83 mi./sq.mile open road density. BAA 7-6-1 would retain a 0.91 mi./sq.mi. open road density, until other

projects were completed and the ORD would drop to 0.77 miles per square mile in 1998. BMUs 4 (62.5 percent in 1998 due to Berray Mountain timber sale) and 5 (66.4 percent in 1998 due to Noranda) would not meet the Forest Plan habitat effectiveness standard (70 percent). There would be no increase in total motorized access route density (TMARD) and no decrease in core habitat, thus there would be no incidental take (McMaster 1995). Alternative I is not likely to adversely affect the grizzly bear or its habitat.

Water Howellia. Since this species was not found to be present during surveys and since suitable habitat was not found in the project activity area, there will be no direct, indirect, or cumulative effect to water Howellia or its habitat from any alternative.

Alternative II

Bald Eagle. The potential exists for a stable to declining bald eagle population under Alternative II, as mortality risk would be greatest under this alternative. This would be due to increased truck traffic traveling on Montana Highway 200 to the Herford rail siding, increased traffic and speeds on FDR No. 150 and the increased train traffic required to pickup and haul ore concentrate. Based on Montana Department of Transportation (MDOT) data, traffic on Montana Highway 200 has increased a maximum of only 3.6 percent in any year over the past ten years. Projected increases due to the Rock Creek project are between 30 and 36 percent. Road-kill data on deer (MDOT) show that the normal small increases in average daily traffic (ADT) levels result in up to a 4 percent annual increase in road-kill deer numbers (minimum numbers, as not all road kill is picked up by MDOT). The projected 30 to 36 percent increase in ADT (ten times greater than normal) for the Rock Creek project has the potential to significantly increase road-kill numbers (by up to 40 percent). The increase in road-kills would increase foraging habitat along area Montana Highway 200, FDR No. 150, and the train tracks. The increased food source could result in an increase in the risk of eagles being hit by vehicles. Since removal of road kill is not part of ASARCO's original proposal, there would be no mitigating this effect. Should a bald eagle be hit by a vehicle, and especially if that eagle was part of one of the nesting pairs using the lower Clark Fork, recovery could be delayed in the Upper Columbia Bald Eagle Recovery Zone. The likelihood of this happening is small. Since there is no suitable nesting or winter roosting habitat in the project area, there would be no change in these habitat conditions.

The degree to which bald eagles may be indirectly affected by the proposed project is related to the predicted downstream effects on fish, the primary prey species. Eagles, as the top of the food chain, would be susceptible to accumulation of heavy metals. Metal loading from the project is described in the **Hydrology** and **Aquatic/Fisheries**, and is based, in part, on the Troy Mine data. A minor increase in toxic metals, which can increase stress to aquatic life, could occur in Rock Creek. Metal levels would remain below Montana cold-water aquatic life standards. Impacts to aquatic life, from metals loading into the Clark Fork river and Lake Pend Oreille, would be negligible and difficult to measure (minor nitrogen load and large volume of water). The main source of heavy metals would come from a tailing impoundment failure, but the likelihood of failure is very low. Therefore, impacts (due to heavy metals) to the bald eagle would be negligible in both the short and long term.

Sediment and nitrogen loads would temporarily increase (**Tables 2-18, 4-15, and 4-16**), and this would impact aquatic invertebrates which could impact fish (see **Hydrology** and **Aquatics/Fisheries**). The resultant indirect effect to bald eagles would be minor in the short and long term.

Alternative II may adversely affect the Bald Eagle. This determination is based on the effects described above as well as the following: 1) Lower Clark Fork area presently at 50 percent occupancy of potential breeding areas which is below management objective of 68 percent to achieve delisting. Potential loss of existing pair would delay recovery.

Peregrine Falcon. Peregrine falcon use along the Clark Fork River drainage would remain a possibility. The suitable nesting habitat would still be available. Since bald eagles and peregrine falcons generally do not co-habit the same nesting territory, and since there is an existing bald eagle nest site within 1/3 mile of suitable peregrine falcon nesting habitat, the likelihood of a nesting pair moving into the area remains only fair. The use of the area by migrating peregrines could still occur. Indirect impacts to the peregrine from heavy metals found in prey (fish-eating waterfowl) would be a low risk (see above section on bald eagle). Alternative II would have no effect on the peregrine falcon because all potential nesting habitat is kept intact, and there is no known use in the project area.

Gray Wolf. There would be no change in the availability of denning or rendezvous habitat. Space, with limited exposure to humans, would be slightly reduced due the increase in disturbance caused by 24 hour a day and 7 days a week activity. Alternative II would affect an estimated 8,196 acres during construction, but the effected area would drop to 7,308 acres during the operation phase. The increase in human activity would effectively eliminate the suitability of the stream bottom portion of Rock Creek for use by wolves. The increased potential for human-wolf encounters increases the mortality risk for the wolf.

While the overall habitat effectiveness for wolf may drop slightly, this alternative is not likely to adversely affect the gray wolf. This determination is based on: 1) project area is outside of designated gray wolf recovery habitat, 2) there is a lack of confirmed wolf activity in the project area, and 3) there are no known den or rendezvous sites in the project area.

Grizzly Bear. Habitat would be physically changed by the construction of the mill site, waste water treatment plant, tailings impoundment, utility and road corridors, and placement of excavated material at waste and storage sites. There would be a direct, physical loss of 585 acres of grizzly bear habitat under Alternative II (see **Table 4-22**). The increased level of human activity would further displace bears using the Rock Creek riparian area on additional habitat within 1/4 to 1/2 mile of the physically disturbed sites and the human travel routes. Habitat effectiveness would be reduced on an estimated 8,196 acres during construction and 7,308 acres during operations (**Table 4-23**). A portion of the area influenced by the proposed project presently experiences some human disturbance. Disturbance would generally be much greater with the proposal because of the increased intensity (24 hours/day, 7 days a week). Denning habitat, as described by Kasworm and Thier (1992, pgs. 40 and 1993, pg.44), would not be disturbed by the proposed project.

Changes in habitat effectiveness caused by this alternative are all negative (**Table 4-24**).

Alternative II would involve new road construction and existing road reconstruction (some existing roads are currently closed). This activity, in conjunction with planned road closures would result in modified ORD that would not meet Forest Plan standards in two BAAs (**Table 4-21**).

TABLE 4-22
Acreage of Habitat Components Physically Altered by ASARCO Project

Feature	Component	Alt. I	Alt. II	Alt. III	Alt. IV	Alt.V
Tailings Impound and AF	Conifer Forest	0	381	396	396	360
	Graminoid Park	0	5	5	5	5
	Shrub field	0	2	2	2	2
	Bareground	0	2	1	1	1
Mine and AF	Conifer Forest	0	30	38	*	*
Evaluation adit	Conifer Forest	0	9	9	9	9
	Rock	0	1	1	1	1
Transportation Corridor	Conifer Forest	0	93	86	65	53
	Forb Field	0	0	1	1	1
	Grassy (disturbed)	0	1	1	1	1
	Shrub/forb field	0	0	3	3	9
	Huckleberry field	0	1	0	0	0
	Bareground	0	1	0	0	0
Facilities (includes Mill and water treatment sites	Conifer Forest	0	59	65	57	40
	Forb Field	0	0	1	1	1
TOTAL PHYSICAL DISTURBANCE		0	585	609	542	483

Note: Physical changes are approximately 67% on National Forest lands and 33% on Private lands

AF = Associated Features

* = Mine and Facilities on same location, acre shown under Facilities acress rounded to nearest whole acre (when component less than one acre, one acre used)

TABLE 4-23

Total Space Influenced During Construction and Operation Phases

ASARCO Rock Creek Mine	Construction Phase Acres *	Operation Phase Acres **
Alternative I	0	0
Alternative II	8,196	7,308
Alternative III	7,625	7,001
Alternative IV	7,259	6,635
Alternative V	7,044	6,428

* = 1/4 to 1/2 mile or ridge line depending on activity (includes acres from Table 4-26)

** = Exploration and Ventilation adits dropped

TABLE 4-24

Percent Habitat Effectiveness Lost Due to ASARCO

Alternative	BMU 4 (%)	BMU 5 (%)	BMU 6 (%)
1	0.0	0.0	0.0
2	- 0.2	- 1.7	- 0.8
3	- 0.2	- 0.9	- 0.5
4	- 0.2	- 0.6	- 0.3
5	- 0.2	- 0.6	- 0.3

Additional mitigation would be needed to close 4.81 miles of road (1.88 miles of FDR No. 2741, 0.18 miles of FDR No. 2741x, and 2.75 miles of FDR No. 2285) in order to meet the Forest Plan ORD standard in all BAAs. There would be an increase in TMARD in all three BMUs. There would be a 321 acre reduction in core habitat across the three affected BMUs (BMU 4: -25 ac.; BMU 5: -135 ac; BMU 6: -161 ac.) (**Table 4-25**). Incidental take, as defined in the USFWS Incidental Take Statement for grizzly bear on the KNF Forest Plan (McMaster 1995), would occur.

TABLE 4-25

Core Habitat Percent by BMU by Alternative

Alternative #	BMU 4			BMU 5			BMU 6		
	1997	1998	1999+	1997	1998	1999+	1997	1998	1999+
1	60.2	60.2	60.2	60.4	60.6	60.6	52.0	50.6	50.6
2	60.2	60.2	60.0	60.4	60.6	60.4	52.0	50.6	50.4
3	60.2	60.2	60.1	60.4	60.6	61.1	52.0	50.6	51.2
4	60.2	60.2	60.1	60.4	60.6	61.1	52.0	50.6	51.5
5	60.2	60.2	60.1	60.4	60.6	61.1	52.0	50.6	51.5

Core changes in 1998 due to Noranda Montanore mine; Skranak and Harpole mine; and Cedar Gulch Timber Sale.

Core changes in 1999 due to Rock Creek mine.

The summary of the moving windows open and total route density analysis is shown in **Table 4-26**. There are no standards for moving windows route densities in the Cabinet/Yaak ecosystem (CYE) but figures in **Table 4-26** are provided for relative comparisons.

The possibility of direct mortality to grizzly bear from the mine and associated activities exists. Grizzlies could be struck by vehicles accessing the mine or hauling ore, or be shot illegally. The presence of the mine could create an attractant that may result in a nuisance bear. Nuisance bears often are destroyed because they cannot adapt to areas without human influence (ie. garbage).

ASARCO's mitigation, as specified in Chapter 2 under Alternative II would reduce the increased mortality risk caused by the mine operation but the net result would still be an increase in mortality risk from present conditions. This is based on the risks of vehicle and nuisance bear mortality still existing. In addition, no replacement habitat is provided. A minimum of 3074 acres would be needed to assure maintaining the present carrying capacity.

Additional habitat loss (unquantified) would occur as a result of the increased human population. Increased population requires increased housing, and increased housing would result in habitat modification. Also, more people would mean greater recreational use of grizzly habitat. This increases the likelihood of displacement or human/bear encounters. Increased encounters often results in increased grizzly mortality. The operation of this project reduces the north to south habitat corridor on the east side of the Cabinet Mountains. Constricting this movement corridor could impact a third of the known grizzlies in the CYE.

TABLE 4-26

Moving Windows Route Densities (% BMU by Route Density Category)[1]

BMU 4	Open Routes					Total Routes *			
Alt.	0 miles	0-1 miles	1-2 miles	> 2 miles		0 miles	0-1 miles	1-2 miles	> 2 miles
1	46.9	14.1	15.0	24.0		43.9	13.7	14.3	28.1
2	46.7	14.3	14.9	24.1		43.8	13.8	14.2	28.2
3	46.7	14.3	15.0	24.0		43.9	13.8	14.2	28.1
4	46.7	14.3	15.0	24.0		43.9	13.8	14.2	28.1
5	46.8	14.3	15.0	24.0		43.9	13.8	14.2	28.1
BMU 5	Open Routes					Total Routes *			
Alt.	0 miles	0-1 miles	1-2 miles	> 2 miles		0 miles	0-1 miles	1-2 miles	> 2 miles
1	57.9	13.5	15.3	13.3		43.3	16.5	17.1	23.0
2	55.0	15.5	13.7	15.8		43.2	16.3	17.9	22.6
3	56.0	15.4	13.8	14.8		44.2	16.2	18.0	21.6
4	55.9	15.5	14.2	14.4		44.2	16.3	18.3	21.2
5	55.9	15.5	14.2	14.4		44.2	16.3	18.3	21.2
BMU 6	Open Routes					Total Routes *			
Alt.	0 miles	0-1 miles	1-2 miles	> 2 miles		0 miles	0-1 miles	1-2 miles	> 2 miles
1	53.3	13.9	12.9	20.1		37.0	13.2	15.5	34.3
2	48.0	15.6	14.0	23.4		35.1	13.9	15.6	35.4
3	48.4	15.6	14.3	21.7		35.8	14.2	15.6	34.4
4	49.0	15.1	14.3	21.6		36.2	13.9	15.6	34.3
5	48.4	15.6	14.3	21.7		35.8	14.2	15.6	34.4
All Alts.	Open Routes					Total Routes *			
BMU.	0 miles	0-1 miles	1-2 miles	> 2 miles		0 miles	0-1 miles	1-2 miles	> 2 miles
7 #	49.2	15.6	14.5	20.8		45.1	21.7	17.2	16.0
8 #	40.4	17.2	21.8	20.7		36.4	19.5	21.9	22.2
22#	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)

\# No changes from existing conditions

[1] Route density categories are in units of "miles of road per square mile."

Habitat potential is reduced based on direct physical loss of suitable habitat, reduced habitat effectiveness (below 70 percent minimum), reduced core area, and habitat fragmentation. These factors combine to result in a reduction in habitat carrying capacity. This reduced carrying capacity may result in disruption of normal grizzly behavioral patterns, including breeding, feeding or sheltering. In addition, the mortality risk is increased. Since the adverse effects to grizzly bear and its habitat would not be fully mitigated, the biological assessment determination for Alternative II is "may adversely affect" the grizzly bear. Formal consultation with the U.S. Fish and Wildlife Service is required. Informal consultation is on going and formal consultation would be completed prior to the final decision.

Alternative III

Bald Eagle. Bald eagle use along the Clark Fork river would continue to increase, as evidenced by the increase in number of nesting pairs found over the past five years. The increase in road killed deer and the associated risk of bald eagle mortality, as shown under Alternative II, would be less as the increased truck traffic would not travel on the highway, but travel to the Miller Gulch rail siding on improved FDR No. 150. In addition, mitigation is planned that would remove dead animals from the road corridor which would further reduce the mortality risk. The other effects are the same as Alternative II. Because of the mitigated mortality risk, Alternative III is not likely to adversely affect the bald eagle or its habitat.

Peregrine Falcon. Peregrine falcon use along the Clark Fork River drainage would remain a possibility. The suitable nesting habitat would still be available. The likelihood of a nesting pair moving into the area remains only fair. The use of the area by migrating peregrines could still occur. The other effects are the same as Alternative II. Alternative III is not likely to adversely affect the peregrine falcon or its habitat.

Gray Wolf. The planned road closures to meet ORD standards for grizzly bear would benefit big game and thus benefit wolves. There would be no change in the availability of denning or rendezvous habitat. Space, with limited exposure to humans, would be slightly reduced due to the increase in disturbance caused by 24 hour a day and 7 days a week activity. This affects an estimated 7,625 acres during construction, but the effected area drops to 7,001 acres during the operation phase. The improved habitat effectiveness in areas where roads are closed may not compensate for reduced effectiveness on the influence area acres. This is due to the lower elevation of the influence acres, which makes them more suitable for big game winter range (wolf foraging habitat). Mitigation (designed to protect the grizzly, but also benefiting the wolf) through the approved ASARCO Traffic Management Plan, and the requirement to not allow firearms in employees vehicles should be relatively effective at offsetting the increase in mortality risk (professional judgement).

While the overall habitat effectiveness for wolf may drop slightly, this alternative is not likely to adversely affect the gray wolf. This determination is based on the same three reasons identified in Alternative II as well as implementation of effective mitigation, designed for grizzly protection but benefitting the wolf also, as part of the project design (traffic management plan, no firearms, road closures).

Grizzly Bear. There would be a direct, physical loss of 609 acres of grizzly bear habitat due to the mine proposal. The increased level of human activity would further displace bears using the Rock Creek riparian area.

Habitat effectiveness would be reduced on an estimated 7,625 acres during construction, and 7,001 during operations (**Table 4-23**). Changes in habitat effectiveness caused by this alternative are all negative (BMU4 is -0.2%, BMU5 is -0.9%, BMU6 is -0.5%) (**Table 4-24**).

Mitigation for physical habitat loss and reduced habitat effectiveness is planned in the form of replacement habitat. ASARCO would be required to provide 2,692 acres through conservation easements, acquisition, or other means.

The open road density would change as displayed in Table 4-30. With planned mitigation to close 3.67 miles of road yearlong (1.88 miles on FDR No. 2741, 0.18 miles of FDR No. 2741x, and 1.61 miles on FDR No. 2285), this alternative would meet the ORD standard in all affected bear analysis areas except 7-5-2. There would be an increase in TMARD, and no decrease in core habitat (**Table 4-25**). Planned closure of portions of the Chicago Peak and Orr Creek roads may cause the public to resent the grizzly and could result in increased mortality risk.

The possibility of direct mortality to grizzly bear from the mine and associated activities exists. Grizzlies could be struck by vehicles accessing the mine or hauling ore, or be shot illegally. The presence of the mine could create an attractant that may result in a nuisance bear. Nuisance bears often are destroyed because they cannot adapt to areas without human influence (ie. garbage). Mitigation for these effects include an approved ASARCO Traffic Management plan that reduces mine related traffic, no firearms in employee vehicles, bear proof containers for attractants, and removing vehicular killed animals from road right-of-way on a daily basis.

Additional habitat loss (unquantified) would occur as a result of the increased human population. Increased population requires increased housing, and increased housing would result in habitat modification. Also, more people would mean greater recreational use of grizzly habitat. This increases the likelihood of displacement or human/bear encounters. Increased encounters often results in increased grizzly mortality. The mitigation measure requiring an information and education program on grizzly bears would partially reduce this risk.

The operation of this project reduces the north to south habitat corridor on the west side of the Cabinet Mountains. Constricting this movement corridor could impact a third of the known grizzlies in the CYE.

Since the adverse effects to grizzly bear and its habitat can not be fully mitigated, the biological assessment determination is that Alternative III may adversely affect the grizzly bear.

<u>Alternative IV</u>

Bald Eagle. The increase in road killed deer and the associated risk of bald eagle mortality would be same as Alternative III. The water resources and aquatics/fisheries monitoring plans (Appendix H) are integral part of Alternative IV. They would be used to detect any adverse effects in the food chain used by bald eagles. The effects determination is the same as Alternative III - not likely to adversely affect.

Peregrine Falcon. Peregrine falcon use along the Clark Fork River drainage would remain a possibility. The suitable nesting habitat would still be available. The likelihood of a nesting pair moving into the area remains only fair. The use of the area by migrating peregrines could still occur. The use of the area by migrating peregrines could still occur. The other affects are the same as Alternative II. The effects determination is the same as Alternative III - not likely to adversely effect.

Gray Wolf. Space, with limited exposure to humans, would be slightly reduced due the increase in disturbance caused by 24 hour a day and 7 days a week activity. Alternative IV would affect an estimated 7,259 acres of habitat during construction, but the affected area drops to 6,635 acres during the operation phase. The other effects are the same as Alternative III. The biological assessment determination is the same a Alternative III - not likely to adversely affect the gray wolf.

Grizzly Bear. There would be a direct, physical loss of 542 acres of grizzly bear habitat due to the mine proposal. The increased level of human activity would further displace bears using the Rock creek riparian area.

Habitat effectiveness would be reduced on an estimated 7,044 acres during construction and 6,420 during operations (**Table 4-23**). Changes in habitat effectiveness caused by this alternative are all negative (BMU4 is -0.2%, BMU5 is -0.6%, BMU6 is -0.3%) (**Table 4-24**).

Mitigation for physical habitat loss and reduced habitat effectiveness is planned in the form of replacement habitat. ASARCO would be required to provide 2,536 acres through conservation easements, acquisition, or other means.

The open road density would change as displayed in **Table 4-21.** With planned mitigation to close 3.67 miles of road yearlong (1.88 miles FDR No. 2741, 0.18 miles of FDR No. 2741x, and 1.61 miles of FDR No. 2285), this alternative would meet the ORD standard in all affected BAAs. There would be no increase in TMARD, and no decrease in core habitat (**Table 4-25**). Planned closure of portions of the Chicago Peak and Orr Creek roads may cause the public to resent the grizzly and could result in increased mortality risk. The summary of the moving windows open and total route density analysis is shown on **Table 4-26.**

The possibility of direct mortality to grizzly bear from the mine and associated activities and mitigations for these impacts would be the same as for Alternative III.

All of the above affects combine to result in a reduced habitat carrying capacity. This reduced carrying capacity may result in disruption of normal grizzly behavioral patterns, including breeding, feeding

or sheltering. Since the adverse effects to grizzly bear and its habitat can not be fully mitigated, the biological assessment determination is may adversely affect the grizzly bear.

Alternative V

Bald Eagle. The increase in road killed deer and the associated risk of bald eagle mortality would be less than Alternative IV due to reduced ADT (only 300% up during operation). The affects determination is the same as alternatives III and IV.

Peregrine Falcon. Peregrine falcon use along the Clark Fork river drainage would remain a possibility. The effects would be the same as Alternative II. Alternative V is not likely to adversely affect the peregrine falcon or its habitat.

Gray Wolf. Space, with limited exposure to humans, would be slightly reduced due to the increase in disturbance caused by 24 hour a day and 7 days a week activity. Alternative V would affect an estimated 7,044 acres of habitat during construction, but the affected area drops to 6,428 acres during the operation phase. The other effects are the same as Alternative III. The biological assessment determination is the same as Alternative III.

Grizzly Bear. There would be a direct, physical loss of 483 acres of grizzly bear habitat due to the mine proposal. The increased level of human activity would further displace bears using the Rock creek riparian area.

Habitat effectiveness would be reduced on an estimated 7,044 acres during construction and 6,428 during operations (**Table 4-23**). Changes in habitat effectiveness caused by this alternative are all negative (BMU4 is -0.2%, BMU5 is -0.6%, BMU6 is -0.3%) (**Table 4-24**).

Mitigation for physical habitat loss and reduced habitat effectiveness is planned in the form of replacement habitat. ASARCO would be required to provide 2,350 acres through conservation easements, acquisition, or other means.

The open road density would change as displayed in **Table 4-21.** With planned mitigation to close 3.67 miles of road yearlong (1.88 miles FDR No. 2741, 0.18 miles of FDR No. 2741x, and 1.61 miles of FDR No. 2285), this alternative would meet the ORD standard in all affected BAAs. There would be no increase in TMARD, and no decrease in core habitat from the 1998 level (**Table 4-26**). Planned closure of portions of the Chicago Peak and Orr Creek roads may cause bad feelings toward the grizzly and could result in increased mortality risk. The summary of the moving windows open and total route density analysis is shown in **Table 4-25.**

The possibility of direct mortality to grizzly bear from the mine and associated activities and mitigations for these impacts would be the same as for Alternative III. All other effects would be the same as those disclosed for Alternative III.

All of the above affects combine to result in a reduced habitat carrying capacity. This reduced carrying capacity may result in disruption of normal grizzly behavioral patterns, including breeding, feeding or sheltering. Since the adverse effects to grizzly bear and its habitat can not be fully mitigated, the biological assessment determination is may adversely affect the grizzly bear.

Cumulative Effects

There are no forseeable cumulative effects to bald eagles or peregrine falcons or water howellia.

With the Montanore project active in two of the three same Bear Management Units, there would be very little available displacement habitat available for grizzly bears or wolves (see the revised Biological Assessment - **Appendix B**). The cumulative habitat effectiveness in BMUs 4 and 5 would be below the minimum 70 percent level for all alternatives (see **Table 4-27**). In addition, when the two mines are operating, the north-south corridor along the crest of the Cabinet Mountains becomes extremely narrow and could limit grizzly bear and wolf movements between the southern and northern portions of the Cabinet Mountains. Elimination of movement along the ecosystem is not likely, but changes in individual bear behavior is likely. Changes in behavior could result in increased competition for habitat or territory in the restricted area. It could also result in mortality to bears that are forced to move through the disturbed areas.

The Cabinet/Yaak grizzly recovery zone is very small (2,580 square miles). The east half of the Cabinet Mountains provides 35.5 percent of the recovery acres in the Cabinet/Yaak recovery zone (CYE). Fragmenting this portion of the CYE, by having two major mine activities (ASARCO Rock Creek and Noranda Montanore) active at the same time would cut off about 22.2 percent of the recovery zone. This would leave a recovery area that is too small to support the desired recovery population (USFWS 1993, part 2, page 17). In addition, any grizzly bears with an established home range in the south half of the Cabinet Mountains would have a difficult time surviving over an extended time period due to the small area of suitable habitat. At a minimum this habitat constriction would effect 5 (31 percent) of the 16 known grizzly bears in the CYE. Even with mitigations core habitat would be changed from 1998 level (**Table 4-25).** The north to south movement corridor could be further constricted as there are two proposals to access two parcels on the east side of the Cabinet Mountains.

Table 4-27
Cumulative Habitat Effectiveness by BMU by Alternative
(Lowest % HE reached during project period)

Alternative	BMU 4 (%)	BMU 5 (%)	BMU 6 (%)
1 \1	61.6	66.4	71.2
2	61.5	65.3	70.8
3	61.5	65.8	71.0
4	61.5	66.0	71.0
5	61.5	66.0	71.1

Note: Minimum Acceptable Habitat Effectiveness is 70%
Assumes Noranda Montanore project part of existing condition and road closures in place.
\1 Changes from existing condition shown for Alternative 1 are the result of cumulative effects from other projects.

Future timber sales would physically change additional grizzly habitat components, especially by removing conifer forest and creating shrub/forb openings. This type of activity also has the potential to decrease the percent of the BMU(s) available for undisturbed use by grizzly bear (reduce habitat effectiveness)(see **Table 4-27**). Timber sales can also result in increased road densities, which contribute to increased human/bear encounters, that lead to more bear mortalities.

SOCIOECONOMICS

Summary

The socioeconomic effects associated with the Rock Creek project would occur primarily in western Sanders County. Alternative I would allow development of over 1,000 new Sanders County jobs over the next 25 years, primarily in service industries. Local population growth rate are expected to be above statewide rates, generating increased demands for housing and community services.

Alternatives II and III would cause a substantial influx of construction workers (up to 433 workers), who would generally depart after 1 year's employment. Mine operations would directly increase local employment by 355 jobs (including an estimated 200 workers from Sanders County), and would hamper sustainable local economic growth and diversification for many decades (foregoing up to 300 jobs in other economic sectors). Mine facilities would substantially increase Sanders County and the Noxon school district tax bases. Local tax revenues would be shared with other affected jurisdictions and with the state of Montana as specified in the negotiated Hard Rock Mining Impact Plan.

Indirect project effects include increased needs for community services. Some identified local government fiscal impacts would be moderated through the Hard Rock Impact Plan. Depending on the residential locations of immigrating families, school enrollment increases could exceed local school capacities and/or accreditation standards. Some water and sanitation systems are inadequate to serve project-generated growth. Land use along the Clark Fork and Bull River valleys would sustain conversions of about 150 acres to residential and commercial development. Mine permitting would make mineral operations the primary use of the 2,400 acre permit area. About 400 acres of private lands and 100 acres of KNF lands in the proposed impoundment area would be restricted from other uses following project shutdown. Impacts associated with alternatives II through V would restrict disturbance and human uses on about 2,350 to 3,074 acres of private lands to provide for permanent grizzly bear habitat protection.

Alternatives IV and V would have similar but generally reduced effects compared to alternatives II and III. Mine development scheduling would have a moderating effect on the levels of construction period employment and immigration (a peak of 350 construction phase workers), mitigating a major negative socioeconomic effect of Alternative II and III construction scheduling -- the boom/bust development cycle. These alternatives would have mine operations employment of 340 workers, a slight reduction from the 350 workers Alternatives II and III. Land use impacts from grizzly bear mitigations would involve restricting human disturbances and uses on approximately 2,350 acres of private lands.

Alternative I

Over the next 25 years without the Rock Creek project being developed, the population of Sanders County is projected to moderately increase from 9,700 persons (in year 1995) to 10,800 persons in 2020 (NPA DATA Services, Inc. 1993) (see **Figure 4-2**). Alternative I would sustain the development of an expected 1,000 new Sanders County jobs over the next 25 years, primarily in service industries. The local population growth rate is expected to be above statewide rates, generating increased demands for housing and community services. Community service needs are likely to outstrip the ability of local jurisdictions to pay for them (Nicholson 1992). Sanders County is expected to continue its long-term transition from an economy moderately dependent on resource-extraction economy to a more balanced services-, investment-, and retirement-based economy with modest resource extraction. Alternative I would have long term socioeconomic benefits.

Land Use

At such time as ASARCO determines that it no longer needs its lands along Rock Creek, these lands (approximately 640 acres) would be sold to private parties. Those lands within one quarter mine of Montana Highway 200 would likely be subdivided for residential development.

Alternative II

The socioeconomic effects associated with the Rock Creek project would be felt primarily in western Sanders County. Mine development would significantly hinder western Sanders County's capacity to diversify its economic base using its natural amenities, quality of life, and competitive cost structures to lure newcomers whose jobs or work could occur in any location and retirees (Johnson and Rasker 1993; Jobes 1992). Up to 300 future services jobs, mostly in health, education and business

FIGURE 4-2 Historic and Projected Sanders County Population

and

FIGURE 4-3 Alternatives II and III Employment

services, would be foregone through mine effects in the area (Heffner 1991; Power 1992; Swanson 1992a; Nork and Luloff 1992).

Project Employment

Project employment effects would involve four phases: an evaluation adit, mine construction, mine operation, and mine closure/rehabilitation (see **Figure 4-3**). Alternative II would cause a substantial influx of construction workers (up to 345 workers) and mine startup workers (88 workers), who would generally depart after 1 year's employment (see **Figure 4-3**). Mine operations would directly boost local employment by an estimated 355 jobs (including an estimated 200 workers from Sanders County -- a 5 percent increase), and would hamper sustainable local economic growth and diversification for many decades. Peak project employment would require up to 200 local construction workers and up to 233 out-of-area immigrating construction workers.

Immigration Numbers and Patterns

A short-lived (up to 1.5 years) construction immigration boom of up to 483 persons (230 construction workers, indirect workers, and their families) would be expected to move into the area. Mine operations would cause the immigration of an estimated 86 mine and indirect workers starting in year 5. All of these workers would be expected to bring their families into the area. This influx would total 227 persons for the next 30 years including 65 spouses and 77 children.

Temporary Mine Shutdown

Temporary project shutdown would cause a short-term loss of direct local employment of up to 325 jobs. The effects of such a shutdown on indirect employment would depend on the length and nature of the shutdown.

Mine Closure

Mine closure would be expected to cause one-half of the mine workers to leave the area, generating an exodus of 462 local persons. After mine closure, local displaced workers would require extensive training with unknown results.

Income

Based on the estimated 355-employee project payroll, the average mine worker would earn about $27,000 per year, generating an estimated annual payroll of $9.6 million. Indirect employment associated with the mine (estimated 140 long-term workers) would generate an additional annual local income of $1.5 million. Project employment would be expected to raise local wage structures and to cause increased rates of job shifting during project development. These effects would increase local businesses' costs, making some businesses less competitive in national markets and would decrease the rate of local business growth and job creation (Wenner 1992).

Fiscal

Mine facilities would substantially increase Sanders County and the Noxon school district tax bases through property tax on ASARCO property and mine and mill facilities, the Metal Mines License tax, and property taxes from new homes and businesses indirectly associated with the project. Local tax revenues would be shared with other affected jurisdictions and with the state of Montana as specified in the negotiated Hard Rock Mining Impact Plan (ASARCO Incorporated 1997).

Hard Rock Impact Plan

ASARCO has prepared a Hard Rock Impact Plan that was negotiated with Sanders County and other affected jurisdictions (ASARCO Incorporated 1997) and was approved on October 23, 1997. The plan includes a variety of project assessment and reassessment triggers that would be jointly reviewed prior to mine construction. This plan provides a coordinated mechanism for allocating project tax revenues to affected local government jurisdictions that would experience project impacts, but that would not receive appropriate tax revenues from the project, or where project tax revenues would lag behind project-generated service increases. This is the case when adjacent school districts would enroll mine-family students, but would not have mine property value increases, or when worker generated school enrollments jumped before local property tax collections increased. The plan requires impact mitigations including tax pre-payments or other appropriate methods to alleviate inequities in location and timing of government receipts. Some of these payments generally would be treated as credits against the company's future local tax liabilities; other payments and grants to affected governments.

The impact plan identifies the increased capital, operating revenues, and net operating costs to affected local government jurisdictions resulting from mine development. ASARCO has identified how it would address projected incremental effects on local government capital and operating costs identified in the impact plan. The plan includes an ASARCO payment schedule and project conditions that would trigger adjustments or amendments to the plan. The Hard Rock Impact Plan includes monitoring by ASARCO and local government jurisdictions so that discrepancies between the planned project impacts and actual project impacts would be accommodated.

Community Services and Schools

Under alternative II, local governments would have to provide services to rapidly fluctuating populations. Local service providers may need to respond to this by rapid change in staffing and management methods (Wenner 1992).

Schools. It is estimated that about 80 percent of the immigrating children (peak of 115 total children during construction and an average total of 78 immigrating children during mine operations) would be of school age and would enroll in area schools (including at least one child with special education or gifted services needs). An estimated 20 percent of these immigrating children would not attend school (preschool, school dropouts, and home-schooled children). Immigrating school children would increase western Sanders County school enrollments by 4 percent (60 students) during the peak of mine construction and by 3 percent (44 students) during mine operations (see **Table 4-28**). Schools outside Sanders County would experience much smaller increased enrollments.

TABLE 4-28
Immigrating Children by County

	Number of Children (Peak) during Construction Phase				Number of Children during Operations Phase			
County	Not in School	Grades K - 8	Grades 9 - 12	Total Children	Not in School	Grades K - 8	Grades 9 - 12	TOTAL Children
Sanders	15	41	19	75	10	30	14	54
Bonner	5	13	6	24	2	9	4	15
Lincoln	3	9	4	16	2	4	2	8
Total	23	63	29	115	14	43	20	77

Peak school enrollment would increase during year 2 of construction, when student immigration would boost the three-county school enrollments by 63 elementary and 29 high school students (see **Table 4-28**). This influx of new students may exceed school classroom capacities and school accreditation standards in Noxon and Trout Creek schools. Additional classrooms or a temporary waiver of school accreditation standards could be necessary. While other area schools would have sufficient classroom space for these projected enrollment increases, local residents and school administrators may wish to maintain current educational quality by hiring additional teachers rather than increasing class sizes. Rapid student turnover would necessitate increased school workloads to accommodate students with differing educational backgrounds, and to acclimate new students. A departure of students would occur with the end of mine construction.

Water Supply. The estimated long-term increase of 15 households on the Noxon water system and of seven households on the Heron system would be expected to overtax existing systems. The Trout Creek, Thompson Falls, Clark Fork, and Hope water systems could readily accommodate small water demand increases from expected project immigrants. Outside of these water service areas, water for new residences would likely be supplied from private wells. Ground water resources are generally sufficient for expected household needs. Specific local ground water availability has not been established and may be insufficient in local areas.

Wastewater Treatment. Since the Thompson Falls sewage treatment facility is near capacity, demands from immigrating families would be difficult to accommodate. Growth could require additional municipal waste treatment capacity or could force new residential and commercial construction outside of the city limits of Thompson Falls. Most new rural residences would rely on septic tanks for new residential wastewater disposal. Potential problems with construction and operation of new septic systems would be evaluated by on a case-by-case basis as part of county sanitation permitting.

Social Well Being and Quality of Life

Local residents are highly attached to local communities as demonstrated by continued willingness to endure high levels of unemployment, scarce social opportunities, and fluctuating economic conditions (Wenner 1992). New residents and businesses are attracted by recreational opportunities, high environmental opportunities, and desirable settings for families (Baden and O'Brien 1994; Johnson and Rasker 1993; Northwest Policy Center with U.S. Bank 1995). Historic local dependence on national markets and outside economic decisions have previously supported lifestyles which accept economic fluctuations and associated

population changes, instability, and lost opportunities as normal (Freudenburg 1992). Dependence on repeated natural resource cycles has caused major fluctuations in area quality of life and emphasized non-transferable job skills and reduced community self-determination.

Economic and social dependence on resource extraction industries is widely regarded as an economic and social liability because it ties social well-being to declining economic sectors, locking residents into untransferable sets of skills (Baden and O'Brien 1994; Humphrey, 1994). Mining dependence decreases local social and economic capacity by hindering local flexibility, capability, and diversity of social processes (Freudenburg 1992). The project would be expected to increase local labor costs, decrease average education levels, and weaken the sense of community (Swanson 1992c; Bloomquist and Killian 1988; Freudenburg 1992). Mining dependence increases community underemployment and decreases social adaptability (Krannich and Luloff 1991).

Area mineral economists expect that "silver prices must rise above $8.00 per ounce and copper prices must remain above $1.00 per pound for the companies to seriously consider production from the Rock Creek deposit" (McCulloch 1997). Silver prices have been above $8.00 per ounce for 8 of the past 18 years (44 percent of the years) since 1980, and copper prices have been above $1.00 per pound for 14 of the past 18 years (77 percent of the time)(in constant dollars from U.S. Bureau of Mines 1993 and Taylor 1996). Prices for both minerals simultaneously being above these break-even points has occurred in 5 of the last 18 years (28 percent of the period). Over the past 100 years, the long term mineral commodity price trends have been declining relative to average worker wages (U.S. Bureau of Mines 1993; Simon 1981, in Freudenburg 1992), with generally declining silver and copper prices as measured in constant dollars (U.S. Bureau of Mines 1993). Past mineral pricing patterns are not necessarily an indication of future prices; however, they provide one context for assessing the possibility of silver and copper price levels being sufficient to begin and sustain Rock Creek mining. The uncertainty of fluctuating mineral prices and lack of local capability to respond to international markets reimposes community dependence on outside decision makers and reduces local community effectiveness.

Local residents who believe that project benefits are vital to community viability would tend to view project social problems as reasonable tradeoffs for 30 years of mining employment. Those who value small town communities, rural scenic qualities, and a sustainable diversified local economy, would tend to view project costs to be greater than its benefits.

Impacts to social and economic well-being under Alternative II would be significant.

Housing

The project would create a peak housing demand in the second year of construction when an estimated 230 additional households (including construction, operations, and indirect workers) would be expected to immigrate into the area. During the mine-development phase, about 80 immigrating households would be located in the Noxon/Heron area.

Influxes of workers, both during mine development and operations, would cause local housing shortages, generating increases in housing prices and costs, including property taxes. Some seasonal housing could be converted to long-term occupancy (Wenner 1992). Increased housing costs would have the most noticeable effect on fixed-income and elderly residents. Overall, the location and availability of affordable housing would be likely to determine the settlement patterns of immigrants.

Land Use

Land-use-related impacts associated with transportation, recreation, wilderness, and wildlife are described in Chapter 4 sections of the same name and in **Biodiversity** and **Threatened and Endangered Species**. About 400 acres of private lands at the impoundment site, would become unsuitable for most other uses. This site potentially could be logged in 8 to 10 decades after mine closure but probably would not support the same level of forest growth as surrounding lands. A new load-out at the Hereford rail siding would increase industrial uses by 0.5 acres at the Hereford rail siding. Land use along the Clark Fork and Bull River valleys would sustain conversions of about 150 acres to residential and commercial development. About 400 acres of private lands in the proposed impoundment area would be restricted from other more intensive uses for the long term. Impacts associated with Alternative II would restrict uses on an estimate 3,074 acres of private lands for permanent protection of the grizzly bear (see **Threatened and Endangered Species**). This might remove those lands from future residential and commercial (including timber harvest) development.

Indirect land use impacts would include residential and commercial development associated with mine workers. At least one new mobile home park, occupying up to 10 acres, could be developed to serve construction workers. New residential development would be expected to convert agricultural and forest land uses. If one-third (112 workers) of the total employees were to construct new homes on 1 acre lots, a total of 112 acres would be converted to residential uses. The bulk of this new housing development would be expected in the vicinity of Noxon, Heron, and Trout Creek, Montana, and Clark Fork, Idaho. Up to 15 new homes (15 acres) could be developed in the Bull River Valley. An additional 15 acres may be converted for commercial activities. These land-use conversions would be minor, having little effect on area agricultural or forestry uses.

As local areas grow, they may increase the total nutrient loadings in the Clark Fork River. The extent of future developments are expected to become restricted or require more stringent waste water treatment as area water quality reaches the limits of Montana and Idaho water quality standards.

Alternatives III and IV

The reader should refer to the draft EIS for detailed analyses. A summary can be found in Chapter 2, Part V: Comparison of Alternatives.

Alternative V

Local Economy

Mine operations would provide a substantial boost to local employment and economies over the estimated 6 years of mine development and 24 to 30 years of mine operations, but like Alternatives II, III, and IV, implementation of Alternative V would hinder economic development of significant portions in the expanding services sector and would decrease general area attractiveness (see Alternative II, Social Well Being).

Project Employment

Employment effects would be concentrated in western Sanders County. Peak construction employment would require up to 181 local area construction workers, and up to 167 out-of-area immigrating construction workers (peak of 348 construction phase workers) (see **Table 4-29** and **Figure 4-3**). Mine operations would employ an estimated 271 local workers (see **Table 4-29**) and an estimated 69 immigrating workers (total of 340 new workers). Bonner County and Lincoln County would experience minor employment effects .

Evaluation adit construction employment would last for approximately 1 year and would have a peak employment of 63 workers. Mine development, construction, and operations start-up would employ up to 348 workers (see **Table 4-30**). During the estimated 24 years of operations under Alternative V, an average of 340 workers would be employed, and during the two years of mine closure/reclamation an estimated 35 workers would be employed.

As compared to Alternative II, Alternative V would have reduced construction period population effects because of a lengthened construction phase. The longer mine adits and resulting sequencing of construction activities would require approximately 5 years of mine development, construction and operation startup, compared to 3 years under Alternative II (see **Figure 4-4).**

Sequencing of construction activities under Alternative V would limit construction workforce employees (including contracted and ASARCO employees) to a maximum of 350 workers during the 6 years of mine evaluation, development, construction and operations start-up. During these six years, project employment would average roughly 212 workers with frequent fluctuations in workforce numbers and workforce composition (see **Figure 4-4**). Mine construction would be expected to create additional secondary employment totaling an estimated 76 indirect workers (see draft EIS for estimate assumptions). During mine operations, a total of 340 worker would be normally employed for 24 years. Mine operations employment levels would be expected to remain relatively constant except during temporary shutdowns. Ongoing mine operations would be expected to create additional secondary employment averaging 122 workers, of which 90 percent (about 110 workers) would be hired locally and about 10 percent (12 persons) would be immigrating workers.

Immigration Numbers and Patterns

Mine Evaluation, Development and Construction Immigration and Settlement. Most of the 55 contracted mine evaluation adit workers in year one would be expected to be immigrants (80 percent or 50 immigrating workers). Most of these workers would leave at the end of the one year evaluation adit development period. During the two years of mine development (years 2 and 3), of the estimated 73 mine development workers approximately 60 percent would be immigrants, (44 immigrating mine families with 115 persons) who would remain for in the area for four years or more, and many who would become part of the mine operations workforce. During the first year of mine construction (project year 4) about 136 immigrating construction workers with families (estimated 280 persons) would be seeking housing for the 18 month construction period (see **Table 4-31**). The peak project-generated immigration and housing demands would occur during the startup of mine construction and development (year 4) when total project worker immigration would reach a peak of 180 households and 375 persons (see **Table 4-31**). Most of these immigrating construction workers would be expected to leave the area after 18 months (see **Figure 4-4**).

TABLE 4-29 Estimated Local Hires by Job Type for All Action Alternatives

	Alternatives II and III		Alternatives IV and V		
	Total Project Employment	Estimated Local Hire Numbers [1]	Total Project Employment	Estimated Local Hire Numbers[1]	Estimated Local Hire ratio (%)
Construction employment (short-term peak level)					
administrative	30	6	37	7	20 %
technicians[2]	30	10	52	18	35 %
mechanics	60	24	100	40	40 %
eq equipment operators	165	80	68	34	50 %
laborers	60	55	91	82	90 %
CONSTRUCTION TOTAL	345	175	348	181	50 %
Mine Employment (24 or 30 Years of Operations)					
administrative	45	27	45	27	60 %
technicians[2]	40	32	30	24	80 %
mechanics	60	36	51	30	60 %
equipment operators	150	128	164	140	85 %
laborers	60	60	50	50	100 %
MINE OPERATIONS TOTAL	355	283	340	271	80 %

Source: Alternatives II and III are Estimated from ASARCO, Incorporated 1987 - 1994.
Alternative IV and V is estimated from ASARCO, Incorporated 1995 and 1997

Note: [1]Local hires include persons residing in Sanders, Bonner, or Lincoln counties prior to project startup.
[2]Technicians include lumbermen, welders, firemen, mechanists, electricians, warehousemen, carpenters, and janitors.

TABLE 4-30
Project-Related Employment Characteristics - Alternative V

	Evaluation adit		Development Phase				Construction and Operation Startup						Mine Operations		Mine Closure
	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Years 7 through 29/34		Year 30/35 & 31/36
Employment and Work Force type	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	1st half	2nd half	Year 7	Year 29/34	
Project Planning and Evaluation adit Construction (contracted workers)															
Adit Construction	35	55													
Mine Construction (contracted workers)															
administrative							16	21	21	-	-	-			
technicians[1]							24	40	40	-	-	-			
mechanics							60	90	90	-	-	-			
equipment operators							80	34	38	-	-	-			
laborers							93	90	85	-	-	-			
CONSTRUCTION TOTAL							273	275	274	0	0	0			
ASARCO Employment in Mine Evaluation , Development, Construction, Operations and Closure															
administrative	8	8	15	15	15	15	15	15	15	30	42	42	45	45	5
technicians[1]			15	15	15	15	15	15	15	30	40	40	41	41	5
mechanics			7	7	7	7	7	7	7	14	35	35	40	35	5
equipment operators			30	30	30	30	30	30	30	66	150	150	164	164	15
laborers			6	6	6	6	6	6	6	40	50	50	50	45	5
ASARCO TOTAL			73	73	73	73	73	73	73	180	317	317	340	330	35
	Evaluation adit		Development Phase				Construction and Operation Startup						Mine Operations		Mine Closure
TOTAL PROJECT EMPLOYMENT	43	63	73	73	73	73	346	348	347	180	317	317	340	330	35

Estimated average semiannual employment levels from ASARCO, Incorporated 1987 - 1995.
[1]Technicians include lumbermen, welders, machinists, electricians, warehousemen, carpenters, and janitors.

FIGURE 4-4 Alternatives IV and V Employment

During mine production startup (18 months during years 5 and 6), about 50 mine workers and their families (total of 128 persons) would move into the project area, almost completing the total project generated increase of 155 persons in Sanders County population, a 1.5 percent increase. Likewise, Bonner and Lincoln counties would have total project generated population increases of 47 and 20 persons, respectively (0.15 percent increase). **Table 4-31** shows the expected local settlement patterns of immigrating mine operations and indirect workers and their dependents. Based on patterns from the ASARCO Troy Mine (Wenner 1992), about 50 to 100 additional families (up to 160 persons) would be expected to accompany unsuccessful job-seekers into the area.

Mine Operations Immigration and Settlement. The start of full scale mine operations would complete the project caused immigration of the estimated 84 mine and indirect workers late in year 6. All of these workers would be expected to bring their families into the area (see **Table 4-31**). The average mine worker family size would be expected to be 2.6 persons, assuming that 75 percent of the mine workers were married and had an average of 1.2 children.

Beginning in year 7, the total project influx of 222 persons for the next 24 to 30 years including 63 spouses and 75 children would be complete (see **Table 4-31**). Based on a 20 percent annual work force turnover (about 70 workers), the local population would fluctuate by up to 180 persons annually. Local mine workers would be expected to relocate to housing nearer the mine when it became available.

Overall, the location and availability of affordable housing is likely to determine the settlement patterns of mine development and mine operation families (see **Table 4-31**).

Temporary Mine Shutdown/Permanent Mine Closure

Effects from temporary mine shutdown or permanent mine closure would be essentially the same as described under Alternative II.

Income

Average mine worker income would remain at $27,000 per year under Alternative V.

Fiscal Effects

Increases in local government costs would be anticipated as a result of Alternative V development. These costs to cities, schools, and counties would result primarily from mine-related immigration into the area. They would include additional government staffing, capital outlay, and increased support costs. Alternative V would generate the same types of direct increases in government revenues as Alternative II.

Community Services and Schools

Under Alternative V, local governments would have to provide services to rapidly fluctuating populations. Local service providers may need to respond to this by rapid change in staffing and management methods (Wenner 1992). Because construction-phase immigration levels would be about 80 percent of Alternative II levels, Alternative V would have reduced negative impacts on schools and

TABLE 4-31
Expected Settlement Locations of Immigrating Construction, Mine and Secondary Workers - Alternative V

Community	Road Miles to Lower Mill Site	Approx. Population[1]	Existing Housing Stock[2]		Immigrating Worker Settlement[3]				Immigrating Population[3]	
					Construction[3]		Mine Operation		Construction[3]	Mine Operation
SANDERS COUNTY		8,700	Total	Vacant	Workers	%	Workers	%	Persons	Persons
Noxon/Heron area	13	1,400	750	240	70	39%	30	36%	146	80
Trout Creek area	19	1,300	500	60	25	14%	15	18%	51	40
rural Thompson Falls	35	400	260	90	15	9%	8	10%	32	22
Thompson Falls	39	1,500	700	60	15	9%	5	5%	32	12
Plains area	65	1,100	500	75	0	0%	0	0%	0	0
Sanders County study area subtotal[1]		5,700	2,700	530	125	70%	59	70%	261	155
BONNER COUNTY, IDAHO		27,000								
Clark Fork area	32	600	350	80	15	8%	8	9%	31	21
Hope area	42	400	260	100	6	4%	4	4%	13	10
Sandpoint area	57	8,000	4,900	1,800	15	8%	6	7%	31	16
Bonner County study area subtotal[1]		9,000	5,500	2,000	36	20%	18	21%	75	47
LINCOLN COUNTY		18,000								
western Lincoln County	46	1,300	600	100	7	4%	3	4%	14	9
Troy area	49	1,200	500	160	7	4%	3	4%	14	8
Libby area	61	3,300	1,600	330	5	3%	1	1%	11	2
Lincoln County study area subtotal[1]		5,800	2,700	600	19	10%	7	9%	39	20
3 COUNTY POPULATION[1]		53,700								
TOTAL STUDY AREA[1]		20,500	10,900	3,100	180	100%	84	100%	375	222

Source: ASARCO, Incorporated 1987-1994; U.S. Bureau of Census 1993.
Note: [1]Population estimates for study areas of each county do not add up to the total county population.
[2]Housing stock includes all seasonal and permanent housing, including housing for rent, for sale or vacant.
[3]Family and population figures include immigrating mine employees and other workers who immigrate to take derivative employment induced by the project. Construction estimates are for the peak construction employment.

other public service providers. The three-county school enrollments would increase by a maximum of 69 students, including 48 new elementary and 21 new high school students (**Table 4-32**). The Sanders County school enrollments during the construction peak would total about 45 new project associated students, closely matching the 40 long-term new students the project would bring in during mine operations (see **Table 4-32**). This reduces the peak school enrollment influx by about 20 percent compared to the company's proposal (Alternative II) and would reduce the construction phase influx by 15 students (60 to 45 students) as compared to Alternative II. The average mine-construction family would stay in the project area for several months longer than under Alternative II, which could increase the duration of peak community service demands.

Immigrating school children would increase western Sanders County school enrollments by 3 percent (45 students) during the peak of mine construction and less than 3 percent (40 students) during mine operations. Schools outside Sanders County would experience much smaller enrollment increases.

Peak school enrollment would occur during year 4 and 5 of mine construction, when student immigration would boost the three-county school enrollments by 48 elementary and 21 high school students (see **Table 4-32**). This influx of new students may exceed school classroom capacities and school accreditation standards in Noxon and Trout Creek schools. Schools would have to take measures to handle these increases such as described in Alternative II.

TABLE 4-32
School Effects of Immigrating Children by County - Alternative V

	Number of Immigrating Children during Construction Phase Peak				Number of Children during Operations Phase			
County	Not in School	Grades K - 8	Grades 9 - 12	Total Children	Not in School	Grades K - 8	Grades 9 - 12	TOTAL Children
Sanders	15	31	14	60	13	28	12	53
Bonner	5	10	4	19	4	7	3	14
Lincoln	3	7	3	13	2	4	2	8
Total	23	48	21	92	19	39	17	75

After a six month decrease in school enrollments (end of year 5), the mine operation startup would increase project caused enrollment increase to 56 students, of which 40 would be expected to enroll in western Sanders County schools (see **Table 4-32**). This would increase student enrollments in western Sanders County from about 1,400 to 1,440, an increase of less than 3 percent. This increase would place a lesser stain on school facilities than earlier mine construction-related enrollment fluctuations.

Impacts to agencies and private sector groups providing services for protection, ambulance services, hospitals and physicians, water supply, waste water treatment, solid waste disposal, human services and libraries would be essentially the same as described for Alternatives II through IV.

Social Well Being and Quality of Life

Implementation of Alternative V would result in 24 to 30 years of mining related employment. The suppression of the construction boom immigration and somewhat smaller work force under Alternative V would lessen local population fluctuations. However, the same general types of impacts described for Alternative II would still occur but to a lesser degree.

Impacts to social well-being under Alternative V would generally be significant, and would be modestly less than those from Alternative II.

Housing

The project would create a peak housing demand early in the fourth year of project development when an estimated 180 additional households (including construction, operations, and indirect workers) would be expected to immigrate into the area (see **Table 4-31**). ASARCO may financially assist in development of a modest sized trailer camp area that would accommodate a significant number of construction workers (up to 50 units) (Dave Young, ASARCO pers. comm. to Kathleen Johnson, DEQ, November 24, 1997). During the mine-development phase, about 70 to 110 immigrating households would be located in the Noxon/Heron area.

Mine operations workers are generally permanent residents who would be more likely to purchase existing, new, or mobile homes. Approximately 40 percent of the immigrating mine operations families (30 families) would be expected to reside in the Noxon/Heron area (see **Table 4-31**).

Land Use

Roughly 400 acres of private lands at the tailings deposition area would become unsuitable for alternative intensive land uses, such as residential, commercial, or industrial uses. The area would generally be revegetated with trees and shrubs and would be primarily used for wildlife habitat and limited forest products. Because of this site's reduced vegetative productivity (see vegetation), the area might have sufficient forest cover to provide reduced levels of forest cutting 8 to 10 decades after mine closure as compared to surrounding lands. As part of KNF project permitting, the KNF would consider exchanging those KNF lands that would be occupied by mine facilities following project closure (the water treatment site and paste deposit lands) to ASARCO for equivalent lands provided by ASARCO. Such an exchange would unify ASARCO operating responsibility for long-term water treatment and paste deposit operations, and minimize KNF responsibility for project effects after project closures. Because the water treatment site of approximately 20 acres would be devoted to water treatment uses following project closure, alternative lands uses would be precluded for several decades.

The proposed Miller Gulch rail loadout facility would require construction of .5 mile of new rail siding on 1.5 acres and an enclosed industrial ore car loading facility on 0.5 acres. The rail siding and loadout would be located northwest of the existing solid waste transfer site (see **Figure 2-20**). This area would be devoted to industrial uses for the life of the project. During mine closure the structures would be removed, and the site reclaimed.

Indirect land use impacts including residential and commercial development associated with mine workers would remain essentially the same as for alternatives II, III, and IV.

Alternative V would also involve the acquisition of or placement of conservation easements on about 2,350 acres of private lands as part of grizzly bear mitigation actions (see **Threatened and Endangered Species**). This would remove those lands from future residential and commercial uses. This could have a moderate effect on local land uses.

Cumulative Effects

Cumulative impacts are similar for all action alternatives. The Montanore Project combined with the Rock Creek Project would result in slightly increased area populations, noticeable only in the Troy area, as a result of mine worker immigration (see **Table 4-33**).

Employment at the Montanore Mine, located 18 miles south of Libby, would peak at 530 workers during an estimated 3-year construction period. Then, 450 mine operations workers would be employed for a period of 15 years. None of the Montanore operations workers are expected to reside in Sanders County, but an estimated 10 percent (8 workers) from the immigrating Rock Creek mine work force would be expected to reside in Lincoln County (see **Table 4-33**). The project would be expected to cause an immigration of 20 to 25 persons (0.1 percent) into Lincoln County through the year 2015, a minor cumulative socioeconomic impact.

The two mine projects could compete for highly skilled local mine workers. The ASARCO and Noranda training programs and the currently unemployed in Lincoln and Sanders counties could provide a sufficient pool of skilled workers. Therefore, the 80 percent local hiring goal for both projects is feasible even if both mines were to begin operation simultaneously.

TABLE 4-33
Cumulative Mine Projects Population and Immigration Impacts

Year	Projected base population	Projected Population Immigration		Total
		Rock Creek Project	Montanore Project	
Sanders County				
1995	9,000	0	0	9,000
2000	9,410	237	0	9,647
2005	9,700	158	0	9,858
2010	10,050	158	0	10,208
2015	10,170	158	0	10,328
Lincoln County				
1995	17,600	0	0	17,600
2000	17,800	22	319	18,141
2005	18,100	22	319	18,441
2010	18,400	22	319	18,741
2015	18,900	22	0	18,922

Adapted from Montanore Final EIS 1992.

Increasing local subdivision development, such as the proposed Bull Lake Estates subdivision in Lincoln County, are expected to place increasing strains on local governments because the local government property tax revenue increases do no normally cover the costs of providing government services to the new subdivisions. Typical local government costs of providing infrastructure and local government service support are typically more than $20,000 per new subdivision lot (Fodor 1996), which are gradually and incompletely recovered from property taxes subsequently paid on the new improvements.

TRANSPORTATION

Summary

The action alternatives would affect between 16 and 22 miles of existing National Forest roads. Traffic patterns, safety, and volumes would be affected to a greater or lesser degree for all action alternatives. Traffic on Montana Highway 200 would increase from about 30 to 36 percent over 1993 traffic volumes. Traffic volumes on the National Forest transportation system within the affected area would increase by 2,300 to 2,800 percent under alternatives II through IV and would increase by only 1,100 percent for Alternative V as a result of busing employees and eliminating ore concentrate hauling. Soils and vegetation disturbance would range between 33 to 65 acres, and 43 to 82 acres, respectively, for the action alternatives.

Impacts associated with access to alternative rail loadouts differ: the ore concentrate trucks would operate on Montana Highway 200 and FDR No. 150 for Alternative II and operate only on FDR nos. 150 and 150B for alternatives III and IV. Alternative V would have no ore concentrate trucks as the concentrate would be piped to the rail loadout facility.

Alternative I

Future Forest Service ecosystem management activities such as wildlife burns, timber sales, and other activities would cause short-term (from less than a week to 2 to 3 years) increases in traffic volume and pattern. There are no current plans for capital improvements to the roads or bridges for forest activities. Road maintenance could be expected to remain at current levels.

Alternative II

Road Construction/Reconstruction

Under Alternative II, 7,100 feet of new road diverging from Montana Highway 200, and an additional 5,900 feet of road around the mill site would be constructed along the FDR No. 150. This alternative has 4-plus miles of construction and about 5.3 miles of reconstruction.

The proposed new segment of FDR No. 150 would cross some unstable soils in the vicinity of Montana Highway 200. The magnitude of unstable soils in this area is unknown, but construction of the road in these soils would increase costs associated with soils stabilization. The proposed approach to Montana Highway 200 does not meet Montana Department of Transportation's requirements for sight distance.

Three bridges on FDR No. 150 would need to be constructed over Rock Creek; one new and two replacements. The new bridge would cross Rock Creek somewhere in the vicinity of milepost 2 on existing

FDR No. 150. This general area of the creek has a large 200- to 300-foot flood plain with some braided channels. The two bridge replacements would be installed in their existing locations over Rock Creek (mileposts 2.3 and 5.0), moving slightly up- or downstream to accommodate the road's horizontal alignment. A short addition to the 6-foot-diameter culvert on the West Fork Rock Creek near its confluence with the East Fort would be required.

Road reconstruction designs would use as much of the existing road alignment as possible. Any remaining road segments would be obliterated and revegetated. Sediment movement into stream courses would be minimized using erosion-control techniques along or when crossing streams, and by using BMP's in road design and construction.

The mine adit access road would be about 8,800 feet long. Construction of this road segment could generate up to 60,000-plus cubic yards of soil and rock for road building and turnouts. On slopes over 55 percent, the roadway would be built entirely on the excavated (cut) side of the slope and not on the embankment (fill) side. There will be visual impacts and potential possibility of sedimentation into Rock Creek.

Aggregate Source. It is estimated that upwards of 50,000 cubic yards of aggregate would be needed for road construction and reconstruction. The tailings impoundment starter dam borrow areas may provide a source of aggregate (gravel) for road construction and reconstruction. An additional source of aggregate would be evaluation adit waste rock.

Rail Loadout

The Hereford rail siding is located 3.5 miles northwest of Noxon, adjacent to Montana Highway 200 and Montana Rail Link track on private land. Access from the highway to the tracks is provided by about 0.25 mile county road. About eight concentrate trucks would travel 6 miles from the intersection to the load-out facility with FDR No. 150 on Montana Highway 200 during a 24-hour day. The concentrated ore that would be shipped by truck and rail is not considered a hazardous material under current hazardous material classification (Dave Young, ASARCO, Incorporated, pers. comm. to Paul Kaiser, April 20, 1994).

Traffic Volume

During the construction phase, about 400 workers would travel to the mill/mine site daily. There would be about 50 service/supply trucks delivering construction materials daily. This combined traffic would result in a potential 450 round trips on the road, or 900 average daily traffic (ADT). During the operation phase, there would be about 355 employees making up a three-shift per day, 7-day week. Three shifts per day would generate a maximum of 355 round trips per day, or 710 ADT. Along with service, delivery, and trucks hauling concentrate, the total traffic from mine operation would be 740 ADT.

Traffic during both the construction and operational phases would increase traffic volume on state highways leading to the mill entrance road. This increase in traffic would be greatest on Montana Highway 200. Using the maximum ADT for the construction phase would place a 71 percent increase in traffic on Montana Highway 200.

FDR No. 150 would experience a 2,800 percent increase in traffic during construction, from 33 to 933 ADT. A double-lane road is necessary to handle this traffic. ASARCO has stated that they would

encourage carpooling to minimize the impact on road use (Dave Young, ASARCO, Incorporated, letter to Paul Kaiser, September 17, 1993). However, past experience with carpooling at the Troy Mine did not meet with great success.

The traffic pattern during the construction phase would be heaviest in the early morning and late afternoon. Increases in early morning and late afternoon traffic would increase the risk of vehicle-wildlife accidents on both FDR No. 150 and Montana Highway 200 (see **Biodiversity** and **Threatened and Endangered Species**).

Truck traffic associated with the rail load-out would generate 16 ADT, adding a little over 1 percent to the existing traffic. It would be less than 1 percent when the ADT for the mine workers is taken into account.

Traffic Management

A road surface would need to be maintained for traffic movement on FDR No. 150 during road construction and reconstruction for passenger cars and delivery trucks. ASARCO would need to develop a traffic plan to allow private landowners reasonable access to their property, and public access to National Forest lands. Delays could happen during reconstruction activities.

Road Maintenance

The maintenance of roads used by ASARCO for mine operation, by the public, and Forest Service administrative and commercial traffic, would be prorated commensurate with use by each party. Those road(s) used solely by ASARCO would be ASARCO responsibility. The increased amount of maintenance by ASARCO would keep FDR No. 150 open to the public year-round, resulting in increased recreational traffic and activities and indirect impacts to other resources (See **Recreation, Biodiversity, Threatened and Endangered Species**, and **Wilderness**).

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Road Construction/Reconstruction

For the most part, the proposed road construction and reconstruction locations would not change from Alternative IV. However, the alignment of FDR No. 150 has been shifted near the waste water treatment facility to potentially take advantage of an existing old road prism. The change of the adit portal location to within the mill site eliminates the need for an overpass structure over FDR No. 150 within the mill site. FDR No. 150 above the mill site entrance and through the north permit boundary would be a single lane aggregate surfaced road, with intervisible turnouts (turnouts visible from the next turnout in each direction). This alternative will reduce sediment loadings to surface water and reduce visual impacts compared to Alternative IV. One bridge would need to be replaced at M.P. 5.0 on FDR No. 150 and a new bridge, over Engle Creek, for the connecting segment of FDR No. 150 to State Highway 200. The existing bridge on FDR

No. 150 at M.P. 2.3 would be adequate for the proposed traffic; potential repairs to the bridge may become necessary during the mine operation life. This reduction in one bridge replacement would reduce sediment loading to surface waters. BMP's would be used during all construction/reconstruction activities. During mill site construction activities, any native or aggregate surfaced road will have a dust palliative used to control dust creation.

Rail Loadout Road Access

The proposed pipeline for ore concentrate would not eliminate the need for a road to the rail loadout facility. The proposed enclosed rail loading facility will reduce the amount of road necessary within the rail loadout area, thus reducing potential long term sedimentation into surface waters. Due to a reduction in ADT, from 16 to 4, for this facility, the rail loadout access road can be a single lane, aggregate surfaced road. The route to the rail loadout facility would be from State Highway 200 and Sanders County Government Mountain road. Mine related traffic needing to go to the rail loadout facility from the mill site would travel down FDR No. 150 to State Highway 200, along Montana Highway 200 to Government Mountain road, and then up Government Mountain road to the Rail Loadout Access road. FDR No. 150B would not be used for this access from the mill site.

Traffic Volume

Busing and required carpooling may decrease the ADT over Alternative IV during mill and adit construction (see **Table 4-34**). A decrease of peak ADT could be expected to go from 636 to about 400, for a 37% decrease in traffic from Alternative IV. The lowest ADT would be the first two years with about 80, increasing to 210+ ADT in year three and in year four increased to 540+ ADT and in year five it is 430 ADT. The large increase in years three and four is due to the hauling of adit waste rock to the tailings paste facility. These ADT's are from Montana Highway 200 to the support facility at M.P. 3. ADTs from the support facility to the mill site would vary by year from 37 to 55 percent less.

Mine related traffic would be at the highest level during construction of the mill site and adit. The busing proposal for hourly employees, during mine operation, (Hydrometrics 1997) will reduce the ADT on FDR No. 150 for about four miles. The parking lot would be at the waste water treatment facility about one mile up FDR No. 150. This proposal would reduce the ADT, and wildlife/vehicle accidents. The ore concentrate pipeline would eliminate the ore concentrate truck traffic of 16 ADT. The busing and 12 hour shift schedule would decrease the ADT another 150. This would bring the mining related ADT to about 60. The traffic mix of buses, delivery trucks, salaried workers, public, and Forest Service administrative vehicles would still require the road to be constructed to a double lane standard. Total traffic ADT would be about 100 from the parking area to the mill site. This would be a decrease of about 80% in ADT over Alternative IV, from 505 to 100 ADT for the operation phase of the mine.

To accommodate this traffic during years three and four of mine construction, the double lane road segments would need to be constructed during year two. The existing single lane road would not accommodate the 100+ ADT safely during the later years of adit and mill site construction.

TABLE 4-34
FDR No. 150 Traffic Volume Percent Increases

	Alt. I	Alt. II	Alt. III	Alt. IV	Alt. V
Construction Phase at Mill Site					
ADT	33	933	636	636	400
% Increase	--	2,730	1,830	1,830	1,120
Operation Phase at Mill Site					
ADT	33	740	505	505	100
% Increase	--	2,140	1,430	1,430	300

Traffic Management

FDR No. 150B would be gated at the both the junction with FDR No. 150 and near the paste plant facility. This would be about a one mile segment restricted to Forest Service administrative and pipe line maintenance traffic. Access to the paste plant facility would be from Montana Highway 200 and the county's Government Mountain road and FDR No. 150B along the toe of the paste facility. Access to the rail loadout would be along the same state and county roads. Both FDR No. 150B and rail loadout access roads would be signed to discourage public use. FDR No. 150, providing public, ASARCO, and Forest Service administrative traffic, would be open to all traffic. FDR No. 150 would be open in the winter to the mill site, but beyond the mill site the road would not be snow plowed except during construction of the evaluation adit. ADTs for existing FDR No. 150 at M.P. 4.5 is 33. To ensure busing and carpooling would be implemented it would become a part of the mine permit.

All road construction equipment that need to cross the bridge over Rock Creek at M.P. 2.3 would need to be at legal highway loading. Off highway loads would require a structural analysis of the bridge for the type of proposed vehicles to use the bridge.

RECREATION

Summary

For all action alternatives, most recreational vehicle access in the Rock Creek drainage would continue. Foot and vehicle traffic at the mill site, portals, and tailings impoundment or paste facility would be restricted. Between 4 and 4.5 miles of road would be closed to motorized vehicular access to mitigate impacts to wildlife.

Local population growth would likely increase recreational use in the area. Increased activity in the Rock Creek drainage could reduce the quality of hunting in the drainage if game populations were displaced.

Recreational use would be modified by changes in access, number of users, and lands available for use. Recreational activities which could be affected by any of the action alternatives include hunting, fishing, camping, berry picking, recreational driving, and other related activities.

Alternative I

Recreational opportunities and use levels, patterns, and growth trends would be expected to continue as they now occur or as may be altered by future management activities. Use levels are increasing annually by an estimated 1 to 3 percent.

Alternative II

Most recreational vehicle access in the Rock Creek drainage would continue. However, 4.1 miles of road would be closed to restrict motorized use (while still allowing nonmotorized use) to compensate for mine-related impacts to wildlife. Closures would include 1.88 miles at the upper end of the Chicago Peak Road (FDR No. 2741), the upper 0.18 miles of a spur road (FDR No. 2741x), and the upper 2.75 miles of the Orr Gulch Road (FDR No. 2285). Access on open roads would be temporarily impacted by delays and increased traffic during the construction phase of the project. Mine-related and recreational road use would be mixed for about 6 miles on FDR No. 150.

Public access would be restricted on about 500 acres at the mill site, mine portal site, and tailings impoundment. This would slightly reduce hunting opportunities and other general forest recreational pursuits in the area. Increased mine related activities could also reduce the recreational desirability of the area for some users.

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Impacts would be very similar to those impacts identified in alternate IV. Most recreational vehicle access in the Rock Creek drainage would continue. During construction, access to the Rock Creek drainage could be delayed periodically due to construction activities. Mine-related and recreational traffic would be mixed along the lower 5 miles of FDR No. 150. Vehicle access would be restricted on upper ends of the Chicago Peak Road, FDR No. 2741 (1.88 miles) a spur road FDR No. 2741x (0.18 miles), and on the Orr Gulch Road FDR No. 2285 (1.61 miles). Foot and vehicle traffic would be restricted at the mill site, the portals, the water treatment plant, the paste plant, and the paste facility. These areas would comprise about 409 acres. ASARCO would not allow camping on their lands below the confluence of the east and west Forks of Rock Creek from May to mid-August to minimize potential disturbance to harlequin ducks. Access restrictions would probably have some impact on recreational use in the drainage. Dispersed recreation users, and particularly huckleberry pickers, would be displaced from 2 or 3 favorite camping locations. Other camping sites within the Rock Creek drainage would probably become more congested or would receive higher use levels as a result of the displacement. Hunting opportunities would change. Increased activity could displace some animals, making them less available for harvest. Restricted mine areas would reduce hunting opportunities slightly, but snow plowing of FDR No. 150 could increase hunter access as well.

Busing of mine employees would reduce to some degree the amount of vehicle traffic on FDR No. 150, thus reducing levels of disturbance for recreationists along the road up to the proposed mill site.

WILDERNESS

Summary

Under the No-Action Alternative, use of the CMW would be expected to increase as projected in the Forest Plan. The impacts associated with this proposal would not occur.

Under the action alternatives, mine-related activities outside the CMW would likely be heard, seen, or smelled from some locations within the CMW. The proposed ventilation adit within the wilderness boundary could be noticeable to some wilderness visitors and more visible but less audible under alternatives III, IV, and V than under Alternative II. The ventilation adit under Alternatives III, IV, and V would be less noticeable than Alternative II after reclamation.

Alternative I

Use and character of the CMW is expected to continue as projected in the Kootenai Forest Plan.

Alternative II

Mine-related activities outside the CMW would likely be heard, seen, and/or smelled from some locations within the wilderness. If a proposed ventilation adit was needed within the wilderness boundary, it would be noticeable to some wilderness visitors. About 3000 square feet of surface area would be disturbed, which would affect the natural integrity of the wilderness. Displacement of some wildlife species from areas disturbed by mining activities outside the wilderness could possibly increase some wildlife populations within the CMW. Isolated areas of habitat within the CMW could be altered an/or stressed by increased wildlife use (see **Biodiversity**).

The remote potential subsidence from underground mining beneath the wilderness could cause topographic changes to the surface (see **Geology and Hydrology**).

Additional residents attributed to the proposed project would likely use the CMW to some degree. This could potentially affect other users' opportunity to experience solitude. New wilderness users are expected to make use of lake basins and the trail systems where existing use is the highest. Impacts to solitude would be most apparent around the ventilation adit, if constructed.

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in Chapter 2, Part V: Comparison of Alternatives.

Alternative V

Wilderness impacts would be very similar to those impacts identified in Alternative IV. Mine related activities outside of the CMW would likely be heard, seen, and/or smelled from some locations within the CMW. The potential ventilation adit within the wilderness boundary could be noticeable to some wilderness visitors, but would be less noticeable than in Alternative II. Opportunities for solitude would increase in the Engle Peak and Chicago Peak areas because road closures on the Chicago Peak and Orr Gulch roads would reduce vehicle access to those areas. However, increased human populations in the area could increase visitation to the wilderness, and slightly reduce the opportunities for solitude. A difference between alternatives IV and V would be that sounds associated with the evaluation adit could be somewhat reduced under Alternative V since propane generators rather than diesel generators would be used as a power source. No mine related noises are expected to be audible at the wilderness lakes most often visited by wilderness visitors.

CULTURAL RESOURCES

Summary

Eight historic sites were documented during the cultural resource investigations. All of these properties were determined to be ineligible for listing on the National Register of Historic Places (NRHP) by consensus of the KNF and Montana State Historic Preservation Office (SHPO). No mitigation measures would be necessary prior to impacting these sites.

General Introduction

If any buried artifacts, human remains, or other undiscovered cultural resources are discovered during the construction, the National Historic Preservation Act and the Native American Graves and Repatriation Act require that the SHPO and representatives from area American Indian Tribes (if remains are of aboriginal origin), be notified immediately. A plan would be developed to address each discovery on a case-by-case basis.

Alternative I

No direct, indirect, or cumulative changes or impacts to cultural resources would occur beyond natural weathering and deterioration.

Alternative II

Although eight historic sites were documented during cultural resource investigations, none are eligible to the NRHP and therefore no mitigation measures are required. Two of the sites will be directly affected by the project. The remaining may see increased vandalism, artifact collecting, and inadvertent physical disturbance as a result of increased human activity and accessibility to the sites over the life of the mine.

Alternative V

No NRHP eligible sites will be affected and therefore no mitigation measures are required.

AMERICAN INDIAN RIGHTS

Summary

Under the No-action Alternative, no change in the status of current American Indian Rights would occur. Under the action alternatives, there may be effects on fisheries, wildlife, and vegetation as well as limits on Tribal access during the life of the project that would affect the ability of Tribal members to fully exercise current treaty rights within the project area. These effects may vary in magnitude by alternative but are common to each. Impacts cannot be quantified based on tribal information submitted to date. No specific areas of traditional use or religious significance have been identified by any Tribal representatives.

Alternative I

There would be no change in the status of current treaty rights within the Rock Creek drainage except on those that could be affected by possible timber sales on NFS lands.

Alternative II

The proposed action affects about 584 acres of land within the original 28,000 square miles encompassed by the Hell Gate Treaty. The actual use of this drainage by tribal members with treaty rights cannot be quantified. Additionally, no tribes with aboriginal affiliation to the area have identified specific sites of religious, medicinal, or cultural importance.

However, all interested tribes have voiced concerns about effects to water quality/fisheries and the Confederated Salish and Kootenai Tribes (CSKT) expressed concern over effects to grizzly bear, huckleberries, and medicinal plant resources as well. Under this alternative, bull and westslope cutthroat trout may decline if project impacts create habitat degradation (see **Aquatics/Fisheries**). Brook trout may be impacted as well. Habitat for grizzly bear, a cultural/spiritual symbol for the CSKT, could be fragmented between its north and south ranges, reducing habitat effectiveness, thus reducing opportunities to see grizzlies (see **Threatened and Endangered Species**). Impacts to wildlife habitat/vegetation, old growth, and wetlands could potentially affect plant species of interest to the tribes. Impacts that project-related activities would have on plant-related treaty rights is unknown because other than huckleberries, no specific plant species have been identified as important. Huckleberries at the mill site would become unavailable in the short term.

Tribal access to the drainage would overall increase due to the upgrade of FDR nos. 150 and 2741 but would be restricted from mine facilities sites. Road closures for grizzly bear mitigation would be in place until after operations ceased and reclamation was completed and then would be reevaluated for their respective need to be reopened or remain closed (see **Transportation** and **Recreation**).

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in Chapter 2, Part V: Comparison of Alternatives.

Alternative V

This alternative would directly affect 483 acres of original treaty lands.

Impacts to vegetation-related treaty rights would be less than other action alternatives but cannot be quantified. Huckleberries at the upper mill site would not be affected by project activities. Less bear habitat would be affected and less mitigation would be required to minimize impacts. Tribal access above the confluence of the East and West forks of Rock Creek would remain at current levels although access would be improved between the confluence and Montana Highway 200.

SOUND

Summary

Project development would cause noise impacts from both stationary sources (evaluation adit generators, mill operations, waste water treatment facility, pumping stations and the rail load-out facility as well as the paste plant under Alternative V), and mobile sources (construction equipment, blasting, ore truck and employee traffic). The loudest stationary sounds would be audible within 2 miles under ideal transmission conditions. Under normal conditions, with the effects of topographic and vegetative absorption, project operations noise could be heard for about 0.87 mile. Vehicles traveling FDR No.150 and Montana Highway 200 typically would be heard 0.25 mile and 0.67 mile away, respectively. Mitigation measures and location alternatives could significantly reduce construction and operation noise impacts to the CMW.

Alternative I

The upper Rock Creek area would continue to have quiet sound levels characteristic of rural areas and wilderness lands (Parker 1987), while the lower Rock Creek area would have sound levels primarily influenced by human activities along the Clark Fork River Valley. Existing natural sound levels in the upper Rock Creek drainage ranging from 25 to 32 decibels-A scale (dBA) (Parker 1987) would continue, with occasional elevated noise levels caused by logging and firewood gatherers. Infrequent vehicle use of FDR No. 150 would continue to generate about 50 dBA, while growing traffic levels on Montana Highway 200 would gradually increase local noise levels from an estimated 70 dBA toward 74 dBA as measured at the edge of the roadway. These noises generally would be buffered by terrain or vegetation. Sound levels at the Hereford rail siding would continue as moderately quiet, except for passing trains.

Alternative II

Project impacts are difficult to predict because actual project noise impacts would be a function of 1) existing sound levels, 2) hearer-desired sound levels, and, 3) the characteristics and conduction of noise. The desired Rock Creek drainage sound levels are "quiet" and are generally of a natural origin (Rodman 1987) because most of the area is managed for wilderness, grizzly bear habitat, dispersed recreation and intermittent timber cutting. Expected sound levels would generally not exceed 55 dBA (U.S. Environmental Protection Agency 1974; Harrison, Clark, and Stankey 1980). The project would noticeably increase both the level and character of noises at the mill and mine portal sites. Traffic along project haul roads and operation of the rail load-out would also cause elevated noise levels.

Construction-Phase Effects

The loudest noises would be generated intermittently at the mill site and adits when peak noise levels would reach up to 125 dBA measured at 900 feet for a few seconds during adit and mill site blasting. Noise would be loudest when blasting was carried out at the surface; underground blasting noises reaching the surface would be somewhat muffled. When underground, the primary source of construction noise would be the ventilation fans, which generate 120 decibels. Bulldozers, trucks and other construction vehicles would be expected to generate up to 85 dBA. To provide ventilation during adit construction for both the ventilation and mine adits, 4-foot-diameter fans would operate continuously, generating up to 123 dBA and would be clearly noticeable (45 dBA) up to 1.0 mile away. Diesel-powered generators at the evaluation adit would continuously generate up to 85 dBA of noise for a 12-month period. Chain saws, logging trucks, and other construction equipment used for powerline and tailings pipeline construction would also generate an estimated 110 dBA at 50 feet (audible for 1.0 mile or more). Surface blasting, trucks with inadequate mufflers, and truck back-up alarms could be audible for up to 2.0 miles. During project construction, most activities would be expected to regularly exceed the EPA 55 DBA health and welfare noise guideline (U.S. Environmental Protection Agency 1974).

Operation-Phase Effects

General mine operation noise levels of 52 to 62 dBA would be noticeably louder than the natural upper Rock Creek sound levels (30 dBA), but generally would be lower than mine construction levels (about 86 dBA). Most mine and mill operating sound levels would slightly exceed the EPA 55 dBA outdoor noise guideline. Primary noise sources would be the conveyor, crushing plant, and ball mill, each of which would be expected to produce between 52 and 62 dBA. Underground blasting would be expected to produce peak surface sounds of up to 55 dBA, but generally would be marginally audible at the surface (Parker 1987). Mine and mill site operations sounds reaching the Clark Fork Valley generally would be inaudible. The loudest stationary sounds would be audible within 2 miles under ideal transmission conditions. Under normal conditions, with the effects of topographic and vegetative absorption, noises from project facilities could be heard for about 0.87 mile.

Operations around the tailings impoundment normally would have lower noise levels, but during the first 7 years of mine operations, the ongoing embankment construction would occasionally emit up to 110 dBA. Ore haul trucks and employee traffic would generate increased traffic noise levels along FDR No. 150 and Montana Highway 200. This increased traffic would significantly increase noise levels (from 30 to 70 dBA) on FDR No. 150, but would have smaller noise increases on Montana Highway 200 (increasing levels from 70 to 74 dBA). Vehicles traveling FDR No.150 and Montana Highway 200 typically would be heard 0.25 mile and 0.67 mile away, respectively.

Cabinet Mountain Wilderness

The ventilation intake adit on the north side of Saint Paul Peak (inside the wilderness) would emit an estimated maximum of 67 dBA (based on Harrison 1978). This noise would be substantially above natural ambient wilderness sound levels of 30 dBA. Following construction of the ventilation adit in about the fifteenth year of mine operations, the ventilation fan noise would be expected to be the dominant sound in a 12-acre wilderness cliff area for at least 11 years (see **Figure 4-5**). Because

Figure 4-5 Noise Influence Area in the Wilderness

wilderness visitors expect quiet and solitude, the fan's mechanical sounds would be intrusive to wilderness visitors.

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Project impacts are difficult to predict because actual project noise impacts would be a function of 1) existing sound levels, 2) hearer-desired sound levels, and, 3) the characteristics and conduction of noise. The desired Rock Creek drainage sound levels are "quiet" and are generally of a natural origin (Rodman 1987) because most of the area is managed for wilderness, grizzly bear habitat, dispersed recreation and intermittent timber cutting. Expected sound levels would generally not exceed 55 dBA (U.S. Environmental Protection Agency 1974; Harrison, Clark, and Stankey 1980). The project would noticeably increase both the level and character of noises at the mill and mine portal sites. Traffic along project haul roads and operation of the rail load-out would also cause elevated noise levels.

Construction-Phase Effects

The types and volumes of noise generated during construction under Alternative V would be similar to alternatives II through IV. However, noise emanating from propane generators during the 12 months of evaluation adit construction would be noticeable less than from the diesel generators proposed for alternatives II through IV. The busing of construction workers from the relocated evaluation adit support facilities site and later from the waste water treatment plant parking lot would reduce the frequency of traffic-related noise on FDR No. 150.

Operation-Phase Effects

Mine operations noise impacts would be mitigated by the same mitigations used in Alternative III and IV. The confluence mill site would provide a 25 percent greater noise buffer distance to the CMW than the 1.0 miles buffer at the upper mill site (.25 mile additional as compared to alternatives II and III). Noises reaching the CMW generally would not be expected to exceed the wilderness' normal ambient background noise levels (35 dBA). Retention of forest screening around the mill site and other measures would provide some additional noise attenuation to meet the 55 dBA standard measured 250 feet uphill from the crushing plant and ball mill.

Mitigation measures would reduce the project's major noise sources (construction equipment, ventilation adit, and mining/mill operations) compared to Alternative II, thereby minimizing noise impacts to sensitive noise locations, primarily the CMW and local residences. Locating the rail load-out near to the Rock Creek paste facility and use of a concentrate pipeline would eliminate most noise impacts to residents along Montana Highway 200 and to residences more than 1/8 mile from the load-out facility. The construction of the load-out facility would create normal construction noises for a periods of several months. Busing of employees and piping of ore concentrate to the rail loadout would reduce the frequency of traffic related noise along FDR No. 150 and 150B and the portion of Government Mountain Road by the the rail loadout.

Cabinet Mountains Wilderness (CMW)

The Alternative V wilderness ventilation intake adit would be sited in a near cliff face on the north side of Saint Paul Peak. The sound from the adit fan would normally emit an estimated 67 dBA at the surface but noise mitigations would reduce surface noise emissions by 21 dBA, to an expected level of 46 dBA (quiet room levels). The wilderness ventilation adit would be expected to create elevated noise levels within 400 feet of the adit or on about 12 acres of the CMW (see **Figure 4-5**). The net effect of placing the ventilation adit higher on the ridge and reducing the noise level would be to substantially reduce the wilderness acres where fan noise would dominate (estimated 100 foot radius) as compared to Alternative II. This noise impacted area would be sited in a near cliff face with very low levels of human use. See **Biodiversity** for impacts of ventilation fan noises to wildlife.

Cumulative Effects

The cumulative effect of the Rock Creek and Montanore projects would be to increase the acreage within the CMW where human sounds were noticeable. However, the two projects would not have any areas of noise overlap.

SCENIC RESOURCES

Summary

All action alternatives would result in major and significant visual impacts for the Rock Creek drainage and Clark Fork Valley. The proposed impoundment or tailings paste facility would affect many views in the Clark Fork Valley, including those from Noxon, along portions of Highway 200, and the lower portion of Noxon Reservoir. The form, color, texture and large size of the impoundment or tailings paste facility would contrast dramatically with the surrounding landscape. Effects would last for several decades until sufficient tree and shrub growth could be established on impoundment or paste faces to reduce the contrast with surrounding terrain and vegetation. The proposed and alternate mill sites in the Rock Creek drainage would introduce an industrial facility to a forested landscape and dramatically alter existing views for recreationists and other users of FDR nos. 150 and 2741 and NFS lands near the project. The West Fork mill site would not be visible from any surrounding wilderness peaks. Under Alternatives IV and V, the confluence mill site would be visible to wilderness visitors in background views from Ojibway and Rock peaks in the CMW.

The utility and transportation corridor(s) with cleared rights-of-way and paralleling power- and pipelines would significantly change the existing setting along FDR No. 150 in the Rock Creek drainage. Burial of the pipelines under Alternative V would reduce the visual impacts associated with their presence in the utility corridor.

The proposed Hereford rail loadout under Alternative II would create a significant visual intrusion for surrounding residents. Under alternatives III, IV, and V, traffic and dust associated with the Miller Gulch rail loadout would create a minor visual intrusion for travelers on adjacent Government Mountain road.

Under all action alternatives, construction of the 3-acre waste rock dump and portal area for the evaluation adit would result in minor visual impacts to recreationists in the upper Rock Creek drainage.

Alternatives III, IV, and V, would result in less visual impact compared to Alternative II due to both ASARCO- and Agency-proposed mitigations although impacts for either the tailings impoundment or paste disposal facilities and the mill site would still be major and significant.

Under all action alternatives the Forest Plan VQO of Partial Retention for MA 31 would be met several decades following mine closure. None of the prescribed Forest Plan visual quality objectives (VQOs) or time frames would be achieved under action alternatives during mine life. The impoundment surface under Alternative II may never meet Retention or Partial Retention VQO standards. Additional reclamation requirements and mitigations under alternatives III, IV, and V, would increase the likelihood that mine facilities would meet Forest Plan and VMS VQO standards sooner than Alternative II but not for several decades.

Introduction

Drawing from both Visual Management System (VMS) and Forest Plan VQOs, the Agencies designated VQOs for project facilities to assess visual impact, guide development of visual mitigation measures, and serve as the standard for evaluating long-term reclamation success. These are identified in **bold text** in **Table 4-35.** VMS objectives were selected for most project facilities rather than Forest Plan objectives due to concern for scenic quality in the project area, high viewer sensitivity in the Clark Fork Valley , and the more rigorous standards of VMS objectives compared to the Forest Plan VQOs. A Rehabilitation VQO, a short-term visual management alternative to return existing visual impacts in the natural landscape to a desired visual quality, would be used during life-of-mine while reclamation and other mitigations are implemented.

TABLE 4-35
Long-term Project Visual Quality Objectives (VQOs)[1]

Project Facilities	Visual Quality Objectives[2]	
	VMS	Forest Plan[3]
Rock Creek tailings impoundment or tailings paste facility	**Retention**	Partial Retention
West Fork mill site (including waste rock dumps and utility corridor)	**Partial Retention**	Modification
Confluence mill site (and utility corridor)	**Partial Retention**	Modification
Evaluation adit	**Partial Retention**	Modification
Ventilation adit	Preservation	**Preservation[4]**

1 A Rehabilitation VQO would be applied to all mine facilities during life-of-mine.
2 VQO in bold type would be applied to this project component in the long term.
3 With Forest Plan Revision and creation of MA 31, a Partial Retention VQO would be applied to most mine facilities following mine closure.
4 A Preservation VQO under VMS would prohibit all management activities except for very low impact recreation facilities. A Preservation VQO from the Forest Plan would result in management activities that are not detectable to the visitor.

Alternative I

Under Alternative I, more gradual and less dramatic changes to the landscape would occur in the Rock Creek drainage and Clark Fork Valley near Noxon. The landscape would continue to undergo modifications associated with timber harvesting, fires, commercial and residential development, and other activities.

Alternative II

Alternative II would result in long-term landscape changes from mining operations and the addition of industrial mining facilities to the forest landscape during mine life. Project-related population increases, housing development, increased traffic levels, and secondary economic growth in the Clark Fork Valley would contribute to a more developed setting. This development could extend from Sandpoint, Idaho, to Noxon, Heron, and Thompson Falls, Montana, during the construction and operation phases of the project.

Viewpoints located in the Clark Fork Valley and Rock Creek drainage used in visual simulations of project facilities are shown on **figures 4-6** and **4-7**. Only viewpoints 1, 2 and 4 were used for Alternative II in the draft EIS. Readers would need to refer to the draft EIS for all three simulations of Alternative II; only the simulation from viewpoint 1 is contained in the supplemental EIS. Viewpoint 5 is focused on the alternate mill site used in Alternatives IV and V and viewpoints 6 and 7 were only used for Alternative V.

Evaluation Adit

The evaluation adit's 3-acre waste rock dump and adit portal would create a noticeable landscape alteration. Potential views would extend to portions of the Rock Creek drainage, along FDR No. 150 on Government Mountain and the Clark Fork Valley. The background distance of this adit from most viewpoints in the Clark Fork Valley (greater than 7 miles), and the relatively small area disturbed would decrease impacts to minor levels. Lights for night-time operation or sunlight reflecting off the steel fuel storage tanks and/or building at the adit's portal would be the most noticeable elements of this facility.

Minor reconstruction of 4.6 miles of FDR No. 2741 (Chicago Peak Road), construction of additional turnouts, and a 1,200-foot spur road, would create some landscape scars from cuts and fills. These changes would be noticeable from viewpoints in the upper Rock Creek drainage and the portion of FDR No. 150 within the Snort Creek drainage. Effects would diminish once vegetation was successfully established. Snowplowing on this road would increase its visibility for those winter recreationists who used the upper Rock Creek drainage.

Other support facilities for the evaluation adit also would contribute to visual impact. Some clearing of undergrowth would be necessary for portions of the 6-inch temporary pipeline between the adit and Clark Fork River resulting in short-term and minor impacts. The most visible portion of this clearing would extend down ridgelines from the evaluation adit to the valley floor of the West Fork Rock Creek -- a distance of about 1.5 miles (with an elevation drop of approximately 2,300 feet). Clearing and pipeline location for the remainder of this corridor on the valley floor of Rock Creek and the West Fork Rock Creek adjacent to FDR No. 150 would result in slight visual impacts.

Figure 4-6 Viewpoint locations for Impoundment

Figure 4-7 Viewpoint locations for Mill Site Simulations

Support facilities for the evaluation adit -- office, changehouse, warehouse, and employee parking -- located adjacent to FDR No. 150 in lower Rock Creek, would create the first noticeable project-related change in this part of the drainage. Visual effects of these support facilities would be moderate and the daily movement of personnel on rotating shifts and delivery of supplies to the evaluation adit would extend an industrial character throughout the drainage along Forest Service roads. Buildings would be removed after facilities for the main adit and waste water treatment were operational.

Tailings Impoundment

The proposed tailings impoundment would contribute most to long-term landscape changes, by introducing a large, new, and incongruous landform to the surrounding landscape (see **Figure 4-8**) (See Figure 4-10 in the draft EIS for an additional impoundment simulation). The contrast and visibility of the impoundment would increase over the life of the project as it became larger and height increased above the 80- to 90-foot height of surrounding trees, becoming more of a significant visual intrusion for those who value the existing landscape in the Clark Fork Valley near Noxon. Contrast would remain high until sufficient tree growth was established on the impoundment face following mine closure. It is unlikely that tree or shrub growth of sufficient height or density could be established on the fine tailings and slimes of the impoundment surface (see **Soils and Reclamation**) to blend effectively with the surrounding landscape, impacting recreationists using surrounding trails, roads, and wilderness viewpoints located above the impoundment. Establishment of grass cover during mine operation would reduce the grayish-white color of the impoundment faces, but would still result in a light green or tan color that contrasted with adjacent tree-covered hillsides.

The tailings impoundment under Alternative II would be visible to residents of the Clark Fork Valley surrounding Noxon, Highway 200 travelers, and recreationists using Noxon and Cabinet Gorge reservoirs. Noxon area residents would have middleground views (about 2 miles distant) of the impoundment with locations along the Clark Fork River at Noxon providing the most unrestricted views. Montana Highway 200 travelers would have foreground to middleground views (0.25 to 3 miles distant) of the tailings impoundment where the existing highway alignment provided direct unscreened views of the proposed site. Potential views for highway travelers could extend for several more miles if highway alignments changed or screening vegetation was removed.

Recreationists on and around the lower portion of Noxon Reservoir and upper portion of Cabinet Gorge Reservoir, where screening vegetation was not present, would have unrestricted views of the proposed tailings impoundment. Locations along the west edge of Noxon Reservoir would provide the most unrestricted views of the impoundment. Recreationists and other users of the west loop of FDR No. 150 to Government Mountain would have immediate foreground views (less than 0.25 mile) of the impoundment where this road joins Montana Highway 200. Recreationists using the proposed route of FDR No. 150 southeast of the impoundment would have foreground views of the impoundment.

Mine, Mill and Associated Facilities

The mill site would create an industrial setting on NFS lands within the Rock Creek drainage during operation of the mine. The adit and access roads, conveyor system, substation, and buildings, as well as other support facilities, would contribute to a developed industrial setting dramatically and significantly different from the present forested landscape (see Figure 4-14 in the draft EIS for a simulation of the upper West Fork Rock Creek mill site).

Figure 4-8 Visual Simulation of Proposed Tailings Impoundment (Alt II)

Project facilities would be highly visible (foreground views) to recreationists using relocated FDR No. 150 (where it would skirt the mill site) due to the absence of vegetative screening and high contrast between the industrial mine facilities and surrounding natural setting. The mill and associated facilities would be intermittently visible from FDR No. 2741 (middleground views) to recreationists accessing or leaving the CMW and to recreationists using Government Mountain in the Snort Creek drainage. The mill facilities would be a visual intrusion to those recreationists and forest users who value the existing, more natural setting. Mill facilities would cover approximately 29 acres, with reclaimed postmining topography creating a flat narrow bench along the valley floor approximately 0.1 mile wide and 0.7 mile long that would contrast with the gently sloping valley floor.

The 2,400-foot-long conveyor would create a strong linear feature in the viewed landscape as it dropped approximately 500 feet from the adits to the mill site. The 10-acre waste rock dump would create a permanent, noticeable, and unnatural shape on hillsides above the West Fork Rock Creek. Reclamation and revegetation of the rock dump would be difficult, and its light color and fine texture would persist many years after mining ceased. New roads would create highly noticeable lines on hillsides above the mill site -- the 8,800-foot access road to the adits, the maintenance access road to the surface conveyor transfer point, and temporary access trails for construction of conveyor towers and the powerline to the adits.

Utility and Transportation Corridor

The utility and transportation corridor along Rock Creek would replace the existing tree-lined gravel road with a more developed linear corridor. Changes along FDR No. 150 below the confluence of the East and West forks of Rock Creek with its widened road and paralleling power- and pipelines would result in a cleared, linear, 100-foot wide corridor. An additional slurry and reclaim pipeline and road would be constructed parallel to and above FDR No. 150 on the west side of Rock Creek below Big Cedar Gulch but would not be visible to travelers along FDR No. 150. A 1-mile section of the utility corridor above the confluence would not parallel FDR No. 150 and would not be visible to travelers except near the confluence and mill site. Increased traffic levels would add to the developed character of this corridor and would continue for mine life.

Waste Water Treatment facility

The 10-acre site for the biotreatment system and ion exchange facility located northeast of the impoundment would have moderate visual effects during mine operation. Landscape alteration would result from creation of a level area for the facility on this steeply sloping site. Vegetation clearing also would be necessary, potentially increasing visibility of this facility for travelers and recreationists using the new FDR No. 150.

Hereford Rail Loadout

The proposed Hereford rail loadout would generate significant visual impacts (foreground views) for those residents immediately adjacent to the proposed site. The frequent (every 3 to 4 hour) arrival and unloading of concentrate trucks using the 12-foot high drive-over ramp, and night-time operation lighting would contribute to the visual intrusion for nearby residents.

Effects on CMW Visitors

Visitors to several mountain peaks within the wilderness would be able to see parts of the proposed project (middleground to background views) (see **Table 4-36**). Each of these wilderness peaks is visited by a few hiking parties each summer (see Recreation). Visitors to Goat, Rock, and Engle peaks, or those accessing the CMW by way of the Engle Peak (No. 932) or Wanless Lake (No.924) trails, would have a background view (3 miles and greater) of the impoundment. Neither the mill nor the evaluation adit would be visible from the CMW though associated facilities such as improvements to the Chicago Peak Road could be visible from access trails. The proposed ventilation adit could be visible to wilderness visitors using the north face of Saint Paul Peak. The degree of contrast and impact could vary slightly, depending on final location of the ventilation adit, but would likely be low. Existing roads, timber harvests, and development in the Clark Fork Valley also would be visible in views out of the CMW from these peaks. Proposed project facilities would not be visible from the numerous lake basins, such as Rock, Engle, Wanless, or Saint Paul lakes, within the CMW. Potential effects on wilderness visitors resulting from views of these project facilities could vary, depending on personal expectations.

TABLE 4-36
Project Facilities That Would Be Visible From Wilderness Peaks by Alternative

Project facility	Cabinet Mountains Wilderness Peaks					
	Goat	Engle	Ojibway	Rock	Chicago	Saint Paul
Rock Creek impoundment or tailings paste facility (Alts. II through V)	**X**	**X**		**X**		
Confluence mill site (Alt. IV and V)			**X**	**X**		
Ventilation adit (all)						**X**

Notes: **X** = visible

Compliance With Visual Management System Visual Quality Objectives (VQO)

The industrial duration and character, and length of time required for landscape restoration of the proposed mining operations would make it impossible to meet the prescribed VMS VQOs under any of the action alternatives during mine operation (see **Table 4-35**). Instead, the short-term restoration objective of Rehabilitation would apply in the interim to address on-going reclamation, until the visual quality could be restored to the standards of VMS VQOs several decades after project completion.

The visual mitigation measures proposed by ASARCO in Alternative II would somewhat reduce the visual impact of mine operations in the long term. However, mitigations would not be able to overcome the dramatic differences in form, line, color, and texture between mine facilities and the surrounding natural landscapes to effectively achieve VQOs within the VMS time frames that specify meeting objectives either immediately or within the first year of mine operation.

It may be possible for the visual quality of the face of the tailings impoundment, the mill site, and the utility corridor to be restored to prescribed VMS VQOs several decades after mine closure with successful implementation of ASARCO's proposed mitigation. The ability to meet VQOs would depend on soil

productivity and resulting tree growth. It is unlikely, however, that the top surface of the impoundment would ever meet Retention VQO standards because tree growth would be very slow or stunted under this alternative (see Forest Plan and Soils and Reclamation). Alternative II would significantly affect the project's ability to comply with Forest Service VQOs.

Compliance with Forest Plan VQOs

With the proposed amendments to the Forest Plan to designate new management areas for the permit area (see **Forest Plan Direction**), the Forest Plan VQO of Partial Retention for MA 31 (Mineral Development) would be met several decades following mine closure with the successful completion of reclamation activities and regrowth of vegetation. The impoundment surface under Alternative II may never meet Partial Retention VQO standards. MA 31 would not have a VQO during mine life (see Appendix K - New Management Area Descriptions). The Forest Plan VQO of Maximum Modification for MA 23 would be met during mine life as volunteer trees and shrubs repopulate the cleared rights-of-way, reducing linear edges and re-establishing natural colors and textures.

Alternatives III and IV

The reader should refer to the draft EIS for detailed analysis. A summary can be found in **Chapter 2, Part V: Comparison of Alternatives**.

Alternative V

Viewpoint 6 at Noxon and viewpoint 7 (an aerial viewpoint) shown on **Figure 4-6** has been added to simulated viewpoints to compare construction options of the tailings paste facility, while viewpoint 3 at the the turnoff to Noxon Dam on Highway 200 was not used. From viewpoint 3, the Bottom-Up option under Alternative V would appear similar in form and construction to the impoundment of Alternative IV (see Figure 4-12 in the draft EIS). From this viewpoint, the Top-Down option under Alternative V would not be visible until later years of mine operation.

Evaluation Adit

Visual impacts of the evaluation adit would be similar to those for Alternatives II through IV. The adit would create a noticeable and minor landscape change near the upper portion of FDR No. 2741 (Chicago Peak Road). Minor reconstruction would result in some fresh roadside cuts and fills. Mitigation measures that would treat the shop building at the adit portal to reduce reflection and shield or baffle exterior lights when visible at night from viewpoints in the Clark Fork Valley would help reduce visual impacts to minor levels. Other measures to regrade the waste rock dump to approximate existing contours and revegetate with shrubs, trees and grasses would reduce impacts to low levels and help meet VQOs at the end of operations.

Under Alternative V, support facilities for the evaluation adit would be located at the junction of the Government Mountain Road and Rock Creek Road and would result in moderate visual effects. The location of facilities adjacent to this road junction and the county trash transfer site would result in highly visible project-related changes for travelers on these roads and persons using the transfer site. Like Alternatives II through IV, these support facilities would be removed following completion of evaluation activities or relocated to either the mill site or waste water treatment plant after they became operational.

Tailings Paste Facility and Plant

All tailings paste construction options would result in major and significant visual impacts for the Clark Fork Valley. The paste facility would affect many views in the valley, including those from Noxon, along limited portions of Highway 200 (with retention of roadside trees), and the lower portion of Noxon Reservoir and surrounding hillsides (see **figures 4-9** through **4-18**). The form, color, and texture of the facility and its large size and scale would contrast dramatically with the surrounding landscape. **Figure 4-15** shows the visibility of tailings paste facility without the mitigation where trees would be planted between the facility and Montana Highway 200. Failure of the planting could result from fire, disease or vandalism. With all construction options, visual impacts would begin to decrease with the initiation of final reclamation activity on the deposit, but would remain high until successful revegetation was completed and tree cover was established several decades after mine closure (see following discussion on construction and reclamation of deposition options). Outer faces of the series of approximately 80-foot tall toe buttresses that would be constructed around the base of the paste facility for all options would be reclaimed immediately after construction, helping to reduce their visual impact to lower levels.

If lights were necessary for night-time deposition of paste, they would be shielded or baffled to reduce their visibility from viewpoints in the Clark Fork Valley. ASARCO would also utilize state-of-the art bulb colors to minimize light pollution.

The paste plant would be highly visible from viewpoints in the surrounding Clark Fork Valley following its construction. Though a hillside location adjacent to the paste deposit would provide a topographic backdrop for the plant, its 110-foot height would make it highly visible until the paste deposit created a landform in later years of mine operation that would screen it from valley viewpoints to the west. Painting and/or treatment of the building along with retention of adjacent hillside trees would reduce its impact somewhat.

Alternative V-a Bottom-Up Option

Paste deposition that would begin at the lower (southern) edge of the deposit footprint and move upslope toward the flank of Government Mountain would create a highly visible south face during the first 19 years of mine operation. Outer faces on the southwest and south edges would rise approximately 320 feet above the deposit base to an elevation of 2680 feet and the deposit crest would be located about 0.4 mile from Highway 200. Remaining portions of the east and west faces would be constructed until approximately year 30 of mine operation and would remain highly visible from viewpoints in the Clark Fork Valley during construction (see **figures 4-9**, **4-11, 4-13**, and **4-15** for simulations of the tailings paste facility with Bottom-Up construction). Final reclamation of completed portions of the outermost compacted paste zones, including reshaping outer slopes and planting grasses, forbs, shrubs and trees, would occur every year during construction and would help reduce color contrast of the deposit. Active disturbance would be greatest at approximately year 19 of operations and would cover about 62 percent of the deposit footprint. As outer faces were completed and reclamation was initiated, visual impacts would begin to decrease from high levels. The created paste landform would resemble the impoundment of Alternatives II, III and IV, with other slopes of 3:1 (33 percent) and a relatively flat 178-acre top surface.

Figure 4-9 Visual Simulation of Tailings Paste Facility Bottom-Up Construction from FDR No. 150 . .

4-10 Visual Simulation of Tailings Paste Facility Top-Down Construction from FDR No. 150

4-11 Visual Simulation of Tailings Paste Facility Bottom-Up Construction, Viewpoint #2

4-12 Visual Simulation of Tailings Paste Facility Top-Down Construction, Viewpoint #2

4-13 Visual Simulation of Tailings Paste Facility Bottom-Up Construction, Viewpoint #6

4-14 Visual Simulation of Tailings Paste Facility Top-Down Construction, Viewpoint #6

4-15 Visual Simulation of Tailings Paste Facility Bottom-Up Construction, Viewpoint #7

4-16 Visual Simulation of Tailings Paste Facility Top-Down Construction, Viewpoint #7

4-17 Visual Simulation of Tailings Paste Facility with Bottom-Up Construction without Tree Screening Mitigation from Intersection of FDR No. 150 and Montana Highway 200, Viewpoint # 1

4-18 Visual Simulation of Confluence Mill Site, Viewpoint #5

Design modifications could flatten the outer slopes, incorporate varying slopes ranging from 3:1 to 5:1, and push the crest farther away from the highway to create a more natural appearing landform that would help achieve visual mitigation and reclamation goals.

Alternative V-b Top-Down Option

Under this option, paste deposition that would begin at the uppermost edge of the deposit footprint and move towards Highway 200 would result in a highly visible face towards the Clark Fork Valley throughout mine operation (see **figures 4-10, 4-12, 4-14**, and **4-16** for simulations of the tailings paste facility with Top-Down construction). Deposition would begin at approximately 2740 feet elevation on the flank of Government Mountain and advance towards the south in initial 1-foot thick lifts. Maximum active disturbance for this option is estimated at 121 acres or about 40 percent of the deposit footprint. When construction was completed, outer faces would rise approximately 380 feet above the deposit base, with the deposit crest approximately 0.6 mile from Highway 200. Reclamation of the outer face along the upper edge of the deposit could be initiated about year 14 of mine operation. Reshaping of outer slopes and planting of grasses, forbs, shrubs and trees would help reduce color contrast of the deposit. With initiation of reclamation, visual impacts would begin to decrease from high levels. With this option, the created landform at the end of mine life would more closely resemble natural landforms than the Bottom-Up Option, with outer slopes of 5:1 (20 percent) and a smaller top surface of approximately 70 acres.

Alternative V-c Combined Option

Under this option, paste deposition that would include both Bottom-Up and Top-Down placement of paste could result in maximum active disturbance (approximately 305 acres) between the three deposition options. Active deposition of paste under this option would likely begin at the bottom edge of the deposit to construct the outer zone of compacted paste and help ensure deposit stability, and at some point in mine operation shift to Top-Down deposition adjacent to Government Mountain. Although the outer compacted paste zone could be reclaimed on an annual basis as it was built, its construction would take longer if active deposition shifted to Top-Down construction before its completion. Reclamation of outer faces and the top surface of the Top-Down portion of the deposit could begin in later years of mine operation when design height was reached and deposition reached the outer limit of the footprint.

Final form of the deposit under the combined option would incorporate design components of both Bottom-Up and Top-Down construction, with lower deposit faces at approximately 33 percent slope, upper faces at 20 percent slope, and intermediate slopes transitioning between these two. Maximum deposit elevation would approximate that of the Top-Down option (2740 feet) and acreage of the top surface about 70 acres. The combined option offers opportunity for preferential spigotting of paste and shaping of outer faces and top surface of the deposit compared to the other options, while also depositing the bulk of the paste mass near Government Mountain and away from Highway 200.

Mine, Mill, and Associated Facilities

Under Alternative V, reduction of disturbed acreage at the confluence mill site from approximately 47 to 30 acres, relocation of the mine portal from the east to the west side of FDR No. 150, and elimination of the tailings thickener would slightly reduce visual impacts from those for Alternative IV. The 100-foot minimum buffer of trees that would be retained between FDR No. 150 and the mill site would limit foreground views for recreationists traveling near the mill site. Overall visual impacts would be adverse and

significant due to the presence of an industrial facility in a previously natural landscape and its high visibility from surrounding roads above the mill site (see **Figure 4-18** visual simulation).

Utility and Transportation Corridors

Under Alternative V, visual impacts of the utility and transportation corridor would be less than those for Alternative IV, due to the burial of the pipelines along most of the corridor. The 230-kV transmission line would still parallel paved FDR No. 150 for 4.3 miles in the lower Rock Creek drainage. Pipelines at the three above-ground stream crossings along this corridor would be encased in a secondary pipeline and suspended beneath or adjacent to the bridges. Other shorter segments of utility corridors containing fewer buried pipelines than the main corridor would parallel access roads to and around the paste deposit, to the rail loadout facility, and to the discharge outfall in the Clark Fork River and individually would result in minor visual impacts.

Waste Water Treatment Facility

Waste water treatment facilities including process buildings, in-ground biotreatment cells, above-ground brine storage tanks, and a half-acre aeration pond would result in moderate visual impacts similar to those for alternatives III and IV. Visibility for travelers and recreationists on the new FDR No. 150 would be high until sufficient vegetation could be grown in this recently logged area to effectively screen views from the road. These life-of-mine facilities would be treated or painted to help them blend with surrounding vegetation and landscape.

Miller Gulch Rail Loadout

Placement of facilities necessary for processing concentrate for rail transport into an enclosed building would reduce visual impacts from those described for alternatives III and IV. Pipeline transport of the concentrate to this facility also would help reduce visual impacts from mine traffic and generated dust. The approximately 200-foot long and 50-foot tall building would be treated or painted to visually blend with surrounding vegetation. If lights were necessary for security or night-time operation, shielding and strategic placement would be used to minimize light pollution for nearby viewpoints.

Effects on CMW Visitors

The visibility of the paste deposit from CMW viewpoints under Options a, b and c would increase incrementally during mine life as the paste deposit grew in size and filled the deposit footprint. In later years of mine operation, visibility of the deposit from CMW viewpoints (Goat, Engle and Rock peaks) under Alternative V - Options a, b, and c would be comparable to that of the impoundment under other alternatives unless reclamation had been initiated on the surfaces and top of the deposit. Agency-proposed reclamation measures under Alternative V would be more successful at establishing sufficient tree cover to help blend the deposit surfaces with surrounding terrain than under Alternative II. Under Alternative V, landform shaping of the deposit surfaces and top could help decrease its unnatural engineered appearance.

The confluence mill site would be visible from Ojibway and Rock peaks and the Engle Peak Trail (No. 932) under Alternatives IV and V.

Compliance With VMS VQOs

Project facilities would not meet long-term VMS VQOs during mine operation. Instead the short-term (life-of-mine) VQO of Rehabilitation would be applied to mine facilities until visual impacts in the natural landscape were mitigated to the desired visual quality. Under the new Scenery Management System (U.S. Forest Service 1995), an unacceptably low level of scenic integrity would be applied to mine facilities. None of the action alternatives would meet VMS VQO time frames. It is possible that the VQO of Partial Retention could be achieved for the confluence mill site several decades after mine closure. With natural landform shaping and successful reclamation that replicates surrounding topography and vegetation, it is also possible that the VQO of Retention could be achieved for the paste deposit several decades after mine closure.

Compliance with Forest Plan Visual Quality Objectives

Under Alternative V, the Forest Plan VQO of Partial Retention for MA 31 would be met sooner than under Alternative II due to phased reclamation activity during mine life, greater soil salvage depths and improved vegetation growth, and natural landform shaping of the paste facility and mill pad, but accomplishment of VQO's would still take decades following mine closure. Like Alternative II, the Forest Plan VQO of Maximum Modification for MA 23 would be met as volunteer trees and shrubs reforest the cleared rights-of-way of the utility corridor throughout mine life.

Cumulative Effects - Scenic Resources

Timber sales on NFS and corporate lands and continued commercial and residential development in the Clark Fork Valley, in addition to project facilities, would alter existing views in the project area. Relicensing of Noxon and Cabinet Gorge hydroelectric projects is not expected to contribute to alteration of the existing visual character of the project area or cumulative effects. The Montanore Project on the east face of the Cabinet Mountains would not result in direct cumulative visual impacts to the study area, though indirect impacts may occur for some CMW visitors as either project may be visible from some wilderness viewpoints. Continued exploration for locatable minerals should have no major cumulative effects on the visual setting of the Clark Fork Valley or Rock Creek drainage. Cumulative visual impacts for any action alternative could be potentially significant depending on viewer expectations for the scenic integrity of the landscape, valued landscape attributes, as well as specific views from any viewpoint.

PART 2: PROBABLE ENVIRONMENTAL EFFECTS THAT COULD NOT BE AVOIDED

Forest Plan

The project would require amending the Forest Plan for those areas to be occupied by facilities. The amendments would convert MA 13 (old growth), MA 11 (big game winter range), and MA 14 (grizzly bear habitat) to MA 31 (mineral development) and MA 23 (electric transmission corridor) for the mine life and beyond. Therefore, if this project is approved, management area changes would be made to reflect appropriate designations for proposed uses.

Air Quality

Even after compliance with applicable state and federal ambient air quality and emission standards, there would be some minimal air quality degradation associated with the project. Monitoring of the operation as described in **Appendix H** would verify compliance on an ongoing basis.

Geology

The recoverable portion of the Rock Creek ore body would be permanently removed.

Soils

Soil erosion to some degree would occur under all alternatives, even with implementation of mitigation measures proposed. The degree of impacts varies among the action alternatives. Soil productivity would be reduced in some locations such as the tailings impoundment area where soil profile characteristics would be drastically changed over premine conditions or in areas that would be unreclaimed such as some sections of new road.

Hydrology

The underground mine would produce water that would require disposal. During the operational period of the mine, some excess water would be used at the proposed mill facility, and some excess water would be treated and discharged to the Clark Fork River. After mining was complete, and assuming the mine adits were not sealed, excess mine water would meet State discharge permit requirements and would be discharged to the Clark Fork River. If the adits were sealed after mining, the mine would fill with water until steady-state conditions were reached, where inflow would equal outflow. It is uncertain where outflow from the mine would discharge.

Development of the proposed tailings impoundment would permanently remove more than 300 acres of natural catchment area in the Miller Gulch drainage.

Sediment loading to Rock Creek and the Clark Fork River would increase over baseline conditions due to erosion from mine-related construction in these drainages.

Nitrogen loading below the proposed mill site would temporarily increase during project construction. The increase in concentration cannot be estimated with certainty. All nitrogen would be leached out within 1 to 5 years.

Loading of nutrients and dissolved metals in ground water below the proposed tailings impoundment would increase over baseline conditions. The increase would be limited to an Agency-approved ground water mixing zone and would likely exist over several decades.

Waters of the U.S. and Wetlands

There would be an unavoidable loss of wetlands under all action alternatives.

Aquatics/Fisheries

Declines in fish abundance in Rock Creek could be expected under any action alternative. These declines would be the result of the combined effects of habitat and water quality degradation, of the project and natural events and foreseeable activities. The degree of impact varies between action alternatives.

Biodiversity

Populations of plant species of special concern that would be destroyed include pointed broom sedge, wintergreen, black snake-root, yerba buena, and fringecup. Impacts to these species vary by alternative. Noxious weeds would continue to spread in the region and would be accelerated under all action alternatives.

Wildlife habitat would be affected to different degrees for all action alternatives. Habitat would be directly lost through mine construction, rendered less effective because of increased disturbance, or fragmented because of increased human activities and mine facility development . Wildlife mortality from traffic collisions would increase within the project area and along roads or railroads with mine-related increased traffic. Mortality in some species would increase due to increased poaching or legal harvest. A decline in biodiversity would result from all action alternatives and would be least in Alternative V.

Long term viability of old growth dependent species is unlikely regardless of alternative, until existing stands have sufficiently matured, because of the low amount currently present in the compartment. Long-term viability is least likely with Alternative II and most likely with alternatives I and V.

Indirect effects from increased human development associated with the project would affect wildlife habitat outside of the project area and would likely reduce the biodiversity of the Lower Clark Fork and Bull River valleys.

Mountain goats would experience an increase in disturbance during the mine construction phase.

Threatened and Endangered Species

The project would displace grizzly bears from the project influence area in the long term.

Socioeconomics

Action alternatives would provide increased local employment opportunities, and would cause an immigration of workers and job seekers. This would cause local population fluctuations, boost economic activity and tax revenues, increase social and government service needs during periods of rapid population change and increase local housing costs.

Private lands along Rock Creek, and the Clark Fork and Bull river valleys could be converted to residential and recreational uses. NFS and private lands in the permit area would be devoted to mine uses during the life of the mine.

Transportation

The project would convert certain NFS lands to roads, and traffic and accidents would increase in the project area during mine life.

Recreation

Increased use of and access to the Rock Creek drainage would occur, and recreational use of mine facilities sites would be restricted during mine life.

Wilderness

The CMW would experience increased use, access would be restricted, and mine activities would likely be heard, seen, or smelled from some locations within the CMW.

Cultural Resources

Cultural resources would continue to be impacted by neglect and the indirect impacts associated with increased human activity and growth in the area. These impacts would occur under all alternatives.

Native American Treaty Rights

Potential effects on fisheries, wildlife, and vegetation as well as restrictions on access would limit tribal members from fulfilling their treaty rights during mine life. Some of these effects could last into the long term.

Sound

There would be elevated noise levels in the Rock Creek drainage generated by project construction and operations. Additional traffic would generate slight increases in traffic noises in western Sanders County. Use of the Hereford loadout under Alternative II would increase noise for nearby residents.

Scenic Resources

Visual impacts of all action alternatives would be direct, long term and unavoidable. Existing settings and landscapes in both the Clark Fork Valley and Rock Creek drainage would be dramatically altered during mine operation and for several decades following operation.

PART 3: SUMMARY OF THE RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Forest Plan

The short-term mine construction and operations could devote as up to 147 acres of existing grizzly bear habitat, old growth habitat, and big game winter range to mine-related uses for the life of the project. These changes in use would require amendments to Forest Plan Management Area designations to those appropriate to proposed uses in the short term, and subsequent appropriate revisions to the plan after mine closure. MA 31 (Mineral Development) designations would likely remain in place for the foreseeable future.

Air Quality

During mine life, air pollutant concentrations would be higher than current levels. Once mining and reclamation were completed, the pollutant concentrations would return to premining levels, assuming adequate revegetation success.

Geology

The tailings impoundment would be a permanent facility. The construction of the impoundment and associated dams would irreversibly alter the topography in the impoundment area. Construction of the mill would irreversibly alter the mill site topography.

Soils

Soil losses would be a short-term. Soil productivity decreases would be short-term for much of the permit area. However, soil productivity would be decreased for the long-term (30+ years) in the tailings impoundment location because soil profile characteristics would be drastically changed over premine conditions.

Geotechnical Engineering

Risk of impoundment failure would decrease over time as the impoundment dewatered.

Hydrology

During mining, excess adit water would either be used in the mill or treated and discharged to the Clark Fork River. After mining, flow from the adit would be discharged to the Rock Creek if the adits were not sealed, and the discharge met applicable water quality standards.

During mining, the perimeter collection system would create a barrier to ground water flow in Miller Gulch and recharge would be reduced by about 131 gpm. Recharge would return to premining levels after seepage water quality met applicable water quality standards.

Mill make-up water would be withdrawn from a ground water source near the confluence of Rock Creek and the Clark Fork River during mine operation. Once mining was completed, the need for make-up water would be eliminated.

Waters of the U.S. and Wetlands

Short-term impacts to Waters of the U.S. and wetlands would occur during construction activities due to increased sediment contributions. Proposed BMPs would reduce sedimentation. Other potential short-term impacts would result from time delays between the development and functioning of the created wetlands and the destruction of the existing wetland resources. A long-term impact would result from the 30-year delay in reconstructing the Waters of the U.S. channel at the proposed mill site for Alternative II.

Short- and long-term impacts may occur to wetlands downstream of the proposed tailings impoundment. The capture of surface water by the tailings impoundment and the capture of both surface and ground water by the proposed tailings impoundment seepage collection system would reduce the total drainage area contributing to the wetlands and potentially reduce the duration of saturation, inundation, and ponding of water in these wetlands. Decreased surface and ground water flow, especially during the growing season or dry periods, may allow vegetative species more tolerant of drier sites to replace species requiring more moist site conditions. The use of paste tailings disposal for Alternative V should delay impacts to some wetlands for up to 25 years and thus minimize the total cumulative impacts to wetlands for the short term.

Aquatics/Fisheries

Impacts from the action alternatives would be short term. Most impacts to the aquatic environment, such as increased sediment or impacts from spills, should recover within 30 years. Even if local eliminations of aquatic species should occur, recolonization should generally be rapid once the habitat recovered, particularly for macroinvertebrate and algae species.

However, in the unlikely event of a tailings impoundment failure, impacts on the aquatic environment would be long term. Spills of heavy metals could have long-term impacts on the aquatic environment. If overall habitat degradation was extensive, loss of bull and/or westslope cutthroat trout could be long term or permanent.

Biodiversity

Long-term loss of productivity would occur on the tailings paste facility and other mine developments. Habitat would return to the paste facility but it would probably not be as diverse habitat as originally present for a considerable length of time, if ever.

Increased mortality from illegal or legal kills, or vehicle collisions, may reduce short-term productivity in common species, and affect productivity over a longer term with uncommon species.

Wildlife adapted to open, non-forested areas would likely increase over the short-term within the project area. In the long term, as these sites become reforested, species adapted to forested habitats would increase.

The extent of impacts resulting from the loss of specific sensitive plant populations on the long-term viability of some of these species is unknown. Noxious weeds would continue to spread in the region in the short and long term and the spread would be accelerated under all action alternatives.

Threatened and Endangered Species

The short term effect to bald eagles, peregrine falcon, and gray wolf would be displacement of individuals attempting to use available habitat in the project area. No long term effects are anticipated for bald eagle, peregrine falcon or gray wolf.

Short term effects to grizzly bear include changes in habitat components: a reduction in timbered cover and increase in open grass or shrub fields. The reduction in habitat effectiveness for grizzly bear would be long term (35 years for project activities and up to 25 additional years for physically disturbed sites to provide hiding cover), as would the loss of movement corridors for the grizzly. When a female grizzly is displaced from an area traditionally used, and she has cubs, she is unable to teach her cubs to use the area as she historically did. This means that there could be a delay in the reestablishment of grizzly use in the disturbed habitat for several bear generations (50 years or more) (USFWS 1993, pg 146), after all activity stops. Based on this, grizzly bear use in the Rock Creek mine area may be delayed for 50 years or more.

Socioeconomics

The increased local economic dependence on mining in the short term would retard the expected employment growth of more sustainable service industries in the long term.

Short-term mine construction and operations would devote an estimated 2,000 acres to mine uses for 33 years, including about 700 acres that would be used exclusively for mining. The long-term effect would be the loss of about 400 areas of private timber lands to less productive uses. In addition, between, 2,000 and 3,000 acres (depending on the alternative chosen) of private land would be acquired by fee title or conservation easement for grizzly bear mitigation in the long term.

Transportation

In the short term, winter access would be increased in the Rock Creek drainage up to the mill site. Roads would not be snowplowed once mining ceased, returning access to premining conditions in the long term.

Cultural Resources

Cultural resources are nonrenewable. All short-term uses have the potential for permanent impacts to the long-term historic and interpretive value of cultural resources.

PART 4: IRREVERSIBLE & IRRETRIEVABLE COMMITMENTS OF RESOURCES

Forest Plan

The project would irretrievably devote NFS lands to mining uses for the 35-year life of the project. This would reduce local grizzly, timber, and big game winter range uses in the Rock Creek drainage.

Following completion of mining, about 54 acres of NFS lands would not return to premining uses and would remain as MA 31, into the forseeable future.

Geology

Assuming 70 percent mine recovery, approximately 100 million tons of ore would be removed by the Rock Creek Project, with about 43 million tons left for structural support of the mine workings. Approximately 166 million ounces of silver and 1.37 billion pounds of copper would be removed from underground. Actual overall metal recovery would be slightly less because of mill and smelter losses. Approximately 71 million ounces of silver and 0.59 billion pounds of copper would remain underground in structural supports. Their future recovery is very unlikely. Construction and operation of the Rock Creek Project would result in the irreversible commitment of these resources. Subsidence would be an irreversible effect of mining if it occurred.

Soils

Some soil would be irreversibly lost during construction and operation of the mine prior to the re-establishment of vegetation. Minor adverse effects would result from prolonged soil stockpiling, but following soil replacement, most soils should reach pre-mine productivity levels over time. Soil productivity in the impoundment area would be irreversibly reduced. Soil productivity for areas such as new roads that would not be fully reclaimed also would be irreversibly reduced. Soil productivity would be irretrievably lost for all other unreclaimed areas until the end of mine life.

Hydrology

Water currently stored in joints and fractures above adits and mine workings would be drained and used in the milling process or treated and discharged to the Clark Fork River. Following mining, water would continue to flow into the mine workings. Water levels in the mine would rise until surface discharge occurs along natural pathways or at the mine adits. Use of water stored in joints and fractures would be an irreversible commitment of resources.

Proposed discharges from the passive biotreatment cell would alter the water quality in the Clark Fork River. Tailings impoundment seepage would alter water quality in the ground water mixing zone primarily by increasing the concentrations of nitrogen and metals. Changes in surface water or ground water quality would be an irreversible commitment of these resources.

Ground water quality effects in the impoundment area would decrease following mining operations as impoundment seepage decreases. Some seepage from the impoundment would continue in perpetuity. The tailings are not anticipated to be acid generating, and the quality of the discharge would remain the same or improve with time. Any permanent change in ground water quality in the ground water mixing zone and tailings impoundment areas would be an irreversible commitment of resources.

The withdrawal of make-up water from the Clark Fork River alluvium or the Clark Fork River would be an irretrievable commitment of this resource.

Mining activities would intersect water-bearing joints and fractures during underground operations. The use of stored water would be an irreversible commitment of resources.

Assuming the adit portal could not or would not be permanently sealed, water from the mine would likely discharge to the Clark Fork River in perpetuity. The expected quality of the mine discharge water is discussed in Hydrology. Mine discharge water quality would likely improve with the cessation of underground blasting and mining activities, and likely approach ambient levels in several years. Because the concentrations would be expected to vary with time, the loss of higher quality water in the Clark Fork River would be both irreversible and irretrievable.

Development of the proposed tailings impoundment would modify more than 300 acres of natural catchment area and permanently remove one spring in the Miller Gulch drainage. Alteration of the natural drainage area and the spring would be an irretrievable and irreversible commitment of resources.

Seepage from the proposed tailings impoundment would degrade the quality of ground water in a mixing zone but would be removed as long as the pump-back system was in operation. Seepage would decrease following mining operations. Some seepage from the impoundment would continue in perpetuity. Because the loading rates would be expected to vary with time, a minor reduction in ground water quality in Miller Gulch would be both irreversible and irretrievable.

Overlying surface and ground water resources could potentially be affected if faults or fractures acted as ground water conduits and ASARCO's pilot hole testing and grouting programs were ineffective. As a result, water levels in lakes and surface outflow from the lakes might be reduced. The reduction in flow or in lake level cannot be quantified, and would likely be irreversible, if it occurred.

Waters of the U.S. and Wetlands

There would be an irreversible and irretrievable loss of wetlands and Waters of the U.S. under all action alternatives. Construction of ASARCO's proposed mill facilities, access road, and tailings impoundment for Alternative II would result in the irreversible loss through burial of natural habitat of about 8.1 acres of wetlands. ASARCO’s original proposed wetland mitigation plan, if successful, would create about 12.3 acres of wetlands to compensate for the loss which would replace the functions and values of the destroyed wetlands. An irretrievable loss of approximately 1.5 acres of Waters of the U.S. would also result from implementing Alternative II by the routing the existing drainage channel through ASARCO's proposed mill site facility. The proposed mitigation plan, would recreate the 1.1 acres of Waters of the U.S. at the end of the mining by re-establishing the drainage channel in approximately the same location as it was prior to constructing the mill site.

For Alternative V, there would be an irreversible and irretrievable loss of 6.2 acres of wetlands and 0.4 acres of Waters of the U.S. The proposed mitigation plan would create 7.0 acres of wetlands at three sites along Rock Creek and Miller Gulch. Successful wetland mitigation would compensate for the loss by re-establishing the diversity and abundance of habitat for aquatic and terrestrial species, reducing sediment transport to Rock Creek and attenuating peak flows.

Aquatics/Fisheries

If the impacts of the proposed mine are sufficiently severe to cause the loss of bull trout or westslope cutthroat trout in the Rock Creek drainage, this would be an irretrievable loss of resources.

Biodiversity

Wildlife habitat directly lost through construction of mine facilities not planned for reclamation would be irretrievably lost. The paving of FDR No. 150 would be the most significant of these, because the improved road would continue to affect wildlife by providing a conduit for increased human access long after the mine closes. Reclaimed sites would likely have irreversibly reduced habitat quality because of reduced productivity. Habitat lost as a result of mine-related human development (ie, houses, roads, commercial facilities) would be irretrievably lost. This loss of habitat due to mine-related increased human development is likely to occur over time regardless of mine development but would occur at a more rapid rate, which may lead to the irretrievable lost opportunity to secure key habitat for several species.

Some populations of plant species of special concern would be irreversibly lost. In large part due to lack of knowledge about genetic viability, ecosystem requirements, and species adaptability, current sensitive plant conservation techniques have not been proved to be successful alternatives to avoidance. Noxious weed invasion would displace native species resulting in an irreversible loss of plant species diversity.

Threatened and Endangered Species

There would be no irreversible or irretrievable effects on the bald eagle, peregrine falcon or gray wolf.

Due to the length of the proposed activity (35 years), the loss of available habitat and reduced habitat effectiveness, the habitat carrying capacity for grizzly bear would be reduced. This effect may be irreversible should the loss of the habitat keep the population potential below a viable level. If the population stays below the viable level, the effect becomes irretrievable without large scale augmentation. Future augmentation may be difficult because bears may not be available for relocation from other areas and relocation costs may increase.

Even with reclamation of the tailings impoundment and other areas disturbed by the project, the disturbed areas could have less habitat effectiveness than currently exists. This is based on a high probability of reduced productivity. This habitat loss could further reduce the carrying capacity to the point that a viable level of grizzly bear could not be supported.

Socioeconomics

The action alternatives would irretrievably alter the social and economic life of western Sanders County for up to 30 years. Increased demands for housing, social services, and employment would be irretrievable commitment. Both increased employment and the associated loss of alternative service employment would be irretrievable. The ongoing economic diversification and social structure changes in western Sanders County would be delayed for at least the life of the project.

Land uses directly affected by mining would be irretrievable except for the tailings impoundment site; the land at the tailings impoundment would not be returned to its former productivity. Conversion of land to project-associated development, such as residential and commercial development along Montana Highway 200, would likely be irreversible.

Transportation

The gravel used in road construction and reconstruction would be difficult to salvage for other uses due to the relative shallow thickness (from a few inches up to 1 foot) over the road prism, and to the possibility of contamination with soils and other larger rocks. The asphalt used for the bituminous surface would be difficult to reuse, but bituminous surfaces have been recycled for use in road reconstruction. Commitment of gravel would be irreversible and use of asphalt would likely be.

Recreation

Some of the mine employees could be expected to stay in the area after the life of the mine. Those people could continue to engage in recreational activities in the area. Recreational resource demands would probably be slightly higher after mine closure than future demand without the project. However, it is not expected that mine employee recreational resource needs would significantly deprive other recreationists in the area from enjoying those same resources. Project-related recreation demands would irretrievably commit a portion of the recreation resource in western Sanders County.

Wilderness

Site disturbance associated with the ventilation adit would exist after mine life. Reclaimed disturbance from the adit would consist of a pile of rocks. This rock pile might look unnatural as compared to other rock piles in the vicinity. An irreversible impact to apparent naturalness would occur under Alternative II.

Cultural Resources

Any impacts to cultural resources are irreversible due to the nonrenewable nature of the resources.

Native American Treaty Rights

Impacts to treaty rights would be irretrievable unless the bull trout or grizzly bear was lost due to project impacts. In this case, there would be irreversible loss of those treaty rights.

Sound

The quiet sound levels characteristic of project area rural and wilderness environments would be irretrievably lost.

Scenic Resources

The project would be visible from viewpoints in the Clark Fork Valley, NFS lands, and the CMW. The visual impact of the utility and transportation corridor, evaluation adit, and ventilation adit would significantly affect some viewers. The agency-proposed reclamation and revegetation plan, when completed, would decrease visual effects of mine components. However, the paste deposit for Alternative V, tailings impoundment for Alternatives II, III and IV, both mill sites, and waste rock dumps for all action alternatives would irreversibly alter the natural landscape. Development of these project components would be an irreversible commitment of these visual resources.

CHAPTER 5

CONSULTATION WITH OTHERS

CHAPTER 5: CONSULTATION WITH OTHERS

AGENCIES, COMPANIES, AND ORGANIZATIONS CONSULTED

ASARCO, Incorporated
Bonneville Power Administration
Cabinet Resource Group
Clark Fork - Lake Pend Oreille Coalition
Communities for a Great Northwest
Confederated Salish and Kootenai Tribes of the Flathead Nation
Flathead Electric Cooperative, Inc.
Great Bear Foundation
Idaho Division of Environmental Quality
Kootenai Culture Committee
Kootenai Flyfishers
Kootenai Wildlands Alliance
Libby Area Chamber of Commerce
Libby Placer Mining Company
Libby Tomorrow
Lincoln County Commissioners
Montana Department of Commerce
Montana Department of Fish, Wildlife and Parks
Montana Department of Health and Environmental Sciences
Montana Department of Natural Resources and Conservation
Montana Department of Revenue
Montana Department of Highways
Montana Outfitter and Guides Association
Montana Rail Link
Noranda Minerals Corp.
Northwest Mining Association
Protect Park Resources
Sanders County Commissioners
Sanders County Weed District
Sierra Club
St. John's Lutheran Hospital, Inc.
State Historic Preservation Office
U.S. Bureau of Mines and Geology
U.S. Borax & Chemical Company
U.S. Fish and Wildlife Service
U.S. Mining Safety and Health Administration
Washington Water Power
Western Montana Building and Construction Trades Council
Wharf Resource

COOPERATING AGENCIES

Idaho Department of the Environment
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U.S. Environmental Protection Agency

CHAPTER 6

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CHAPTER 6: PREPARERS AND CONTRIBUTORS

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CHAPTER 7

DISTRIBUTION AND REVIEW OF THE EIS

CHAPTER 7: DISTRIBUTION AND REVIEW OF THE EIS

Copies of this supplemental draft EIS are being provided, either hard or electronic copy, to about 1,054 persons, groups, local governments, and agencies that have expressed an interest in the Rock Creek project. The mailing list was compiled using the names and addresses of:

- parties who participated in public meetings or who submitted written comments;
- parties who have requested copies of the supplemental draft EIS;
- agencies, governments, tribes, and companies potentially affected by the proposed operation; and
- agencies and groups consulted during supplemental draft EIS preparation.

The following agencies, organizations, and individuals received a copy of the supplemental draft EIS or executive summary:

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A copy of this supplemental EIS and the draft EIS can be reviewed at the following locations or via the Internet at the DEQ web page (http://www.deq.mt.gov/eis.htm):

Supervisor's Office, Kootenai National Forest, Libby, MT
Cabinet Ranger Station, Trout Creek, MT
Montana Department of Environmental Quality, Helena, MT
Montana Department of Health and Environmental Sciences, Helena, MT
Montana State Library
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Copies of this document are also available on request from:

Kootenai National Forest
506 U.S. Hwy. 2
Libby, MT 59923
(406) 293-6211

Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620-0901
(406) 444-1760 or 444-4323

CHAPTER 8

GLOSSARY

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acid-base potential. A laboratory method to determine the acid-generating potential of sulfide minerals.

activated sludge. Collection of microorganisms and organic material in an aeration basin with the intent of producing a solid that will settle.

adit. A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and unwatered.

aerie. A bird nest on a cliff or mountainside.

air stripping. A mass of transfer process in which ammonia is removed from water by bringing the water in contact with ammonia-free air. This process reduces the partial pressure of ammonia which causes the ammonia to leave the water phase and enter the gas phase.

alluvium. Soil and rock that is deposited by flowing water.

ambient. Surrounding, existing.

analyte. A chemical to be analyzed in a water quality lab.

appropriators. Persons or corporations that have a legal right to take and use surface or ground water resources.

aquifer. Rock or sediment which is saturated with water and sufficiently permeable to transmit economic quantities of water to wells.

arete. A glacial feature caused by glacial erosion of both sides of a ridgeline.

argillite. A rock that has formed as a result of the hardening of sediments by pressure and heat. Argillite is harder than mudstone and not as hard as shale. The rock is composed largely of particles of clay size and its made up of thin laminates.

background. (air quality) Ambient. (scenic) The viewed landscape from 8 km (5 mi.) to infinity from an observer.

bear analysis area (BAA). A sub-unit of a BMU used to analyze open road densities. Also used to determine the adequate amount of replacement habitat.

bear management unit (BMU). Land area containing sufficient quantity and quality of all seasonal habitat components to support a female grizzly. Used to analyze percent habitat effectiveness (HE).

biodiversity. A term that describes the variety of lifeforms, the ecological role they perform, and the genetic diversity they contain.

biological minimum. in this context, the minimum amount of some component necessary for viability.

borrow materials. Soil or rock dug from one location to provide fill at another location.

breakpoint chlorination. Also known as superchlorination, is accomplished by the addition of chlorine in an amount which will oxidize ammonia-nitrogen to nitrogen gas.

candidate. Those species under consideration for possible listing as "endangered", or "threatened", in accordance with the 1973 Endangered Species Act.

carbonate. A sedimentary rock composed chiefly of carbonate minerals (e.g. limestone and dolomite).

carrying capacity. The maximum number of animals that can be sustained over the long-term on a specified land area.

catchment. A geographic area that collects rain or snowfall.

character type. Pertains to a large physiographic area of land, such as the Columbia Rockies, which has common visual characteristics of landforms, rock formations, water features, and vegetative patterns.

chlorine contact chamber. A basin designed to allow chlorine and bacteria to come in contact, with the intent of killing or reducing the viability of the bacteria.

coarse fragment. Rock that is larger than 2 millimeters (about 1/16 inch) in diameter.

colluvium. Fragments of rock carried and deposited by gravity.

confluence. The point where two streams meet.

conservation assessment and strategy. A biological analysis of species viability and a plan for managing a species that will allow it to survive over time. Includes biological information, current status, and management and monitoring strategies needed to conserve the species.

contrast. The juxtaposition of dissimilar elements (as form, line, color and texture) in the landscape. The closer the juxtaposition of dissimilar elements and the stronger their differences, the more noticeable they become.

construction zone. The area that includes the physical workings of a mine such as adits, roads, mills, tailings ponds, pipelines, and slurry lines.

containerized seedling. A small, young tree held within a container.

corridor. A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.

cutoff. A clay-filled trench beneath a dam to "cut off" water seeping beneath the dam.

cyclone. Centrifugal classifying device.

dBA or decibels A scale. A logarithmic unit for measuring sound intensity, using the decibel A weighted scale, which approximates the sound levels heard by the human ear at moderate sound levels, with a 10 decibel increase being a doubling in sound loudness.

decant water. Water recycled from the tailings pond to the mill for reuse.

deep rip. Breaking up compacted soil, or overburden, to a depth below normal tillage.

degradation. A process by which the quality of water in the natural environment is lowered.

dilution. A process in which the chemical concentration of constituents in a stream decreases as a result of mixing with cleaner water.

dispersal. The movement, usually one way, and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring.

dispersal corridor. A corridor through which young disperse from their area of birth.

dispersed recreation. Recreation that occurs outside of developed sites in the unroaded and roaded environment (e.g., hunting, backpacking, and berry picking).

discontinuity. Any fracture in bedrock, such as faults and bedding fractures; a boundary between seismic layers of the earth.

distance zones. Portions of the viewed landscape that are designated distances from the observer; see foreground, middleground, and background.

downgradient. A direction characterized by lower fluid potential or hydraulic head.

drainage sump. A hole or pit that collects mine waters.

drill seeding. A mechanical method for planting seed in soil.

dynamic flow failure. Landslide movement characterized by fluid-like flow of the landslide material.

earthquake loading. The application of earthquake forces to a structure.

effective old growth. Old growth that not only meets all the age and size class requirements along with typical habitat components such as snags and dead and down logs, but also is large enough or with appropriate shape to allow species dependent on forest interiors to flourish. This is a subjective term with many variables, particularly with regards to the wildlife or plant species affected.

effluent. Waste water discharge.

endangered. Any species, plant or animal, that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.

Endangered Species Act. An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of Interior, in accordance with the Act, identifies or lists the species as "threatened" or "endangered".

environmental stochasticity. Random variation in environmental attributes such as temperature, precipitation, and fire frequency.

ephemeral stream. A stream that flows only as a direct response to rainfall or snowmelt events; having no baseflow.

evaporation. The physical separation of a liquid from a dissolved or suspended solid. Energy is applied to the system to volatize the liquid leaving the solids behind.

extirpated. Exterminated

face. The part of an adit or mine that is actively being excavated; the end of the adit being excavated.

factor-of-safety. Forces causing sliding divided by forces resisting sliding; for example, at a factor-of-safety of 1.0, the forces causing sliding are the same as those resisting sliding.

fault. A fracture or fracture zone where there has been displacement of the sides relative to one another.

fault gouge zone. A soft clayey or clay-like material filling or partly filling a fault zone.

flotation. A mineral recovery process where individual mineral grains are selectively "floated" and skimmed off the top of an agitated water/chemical bath.

forb. Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.

foreground. The viewed landscape from 0 to 0.8 km (0 to 0.5 mi.) from an observer.

fragmentation. Process of reducing size and connectivity of stands that comprise a forest. In more general terms, fragmentation can refer to the state of two or more similar habitat locations separated by a land use or type that is incompatible with the species in question's ability to traverse it.

genus. A group of related species used in the classification of organisms (plural = genera).

glacial moraine. Mounds and ridges of broken rock deposited by glacial action.

ground water extraction system. The configuration of wells and associated pumping rates required to contain or remediate ground water contamination.

habitat effectiveness. the ability of the habitat to be used to its fullest extent for the biological needs of a given species. Habitat effectiveness can be reduced by several factors, such as disturbance or proximity of inappropriate habitat, which may reduce the use of some of the area even though all the necessary habitat components are present.

habituate. Become accustomed to.

hardness. A measure of the amount of calcium, magnesium, and iron dissolved in the water.

heavy metals. Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.

homerange. An area in which an individual animal spends most of its time doing normal activities.

hydraulic conductivity. A measure of the ease with which water moves through soil or rock; permeability.

hydric soil. A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic (water-loving) vegetation. Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.

hydrophytic vegetation. The sum total of plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content. When hydrophytic vegetation comprises a community where indicators of hydric soils and wetland hydrology also occur, the area has wetland vegetation.

hydroseeding. Distributing seed in a spray of water. Mulch and fertilizer may be added to the spray.

impoundment dike. An earthen dam or tailings dam.

indicator species. Species of fish, wildlife, or plants which reflect ecological changes. Forest Service has identified animal species that are used to monitor the effects of planned management activities on viable populations of wildlife and fish. The indicator species for the Kootenai National Forest are: grizzly bear, grey wolf, bald eagle, peregrine falcon, elk, white-tailed deer, mountain goat, and pileated woodpecker.

interior forest bird. Those species whose environmental requirements are best met in stands that are not affected by edge, or those portions of stands that are large enough that edge effects are no longer apparent.

intermittent stream. A stream that does not flow continuously from its source to the mouth, at least for a portion of the year.

introgress. The mixing of genes from two closely related species (hybridization).

ion exchange. A process based on the use of specifically formulated resins. Selective ion exchange for the removal of ammonium is accomplished by passing liquid through a column of zeolite which has a high selectivity for the ammonium ion. After a critical relative concentration of recoverable ion to exchanged ion in the solution is exceeded, the exchange resin, zeolite, is said to be spent. Spent resin is usually recharged by exposing it to a very concentrated solution of the original exchange ion so that a reverse exchange takes place. This results in a regenerated resin and the removal of a concentrated solution of the ammonium ion.

joint. Fracture in rock, generally more or less vertical or transverse.

lacustrine. Pertaining to, produced by, formed in, or growing in a lake.

land application disposal. A method of disposing waste water that relies on sprinkler application over a large area and/or percolation ponds. Disposed water may evaporate, be used by vegetation, or infiltrate to the ground water system.

leachate. A solution obtained by leaching, as in the downward percolation of water through tailings materials, and containing soluble substances.

limit equilibrium analysis. A standard stability analysis.

liquefaction. When an earthquake occurs, energy released by rupturing in the earth's crust causes cyclic waves to travel through the rock and soil mass. Saturated soils can then experience enough pressure between the individual grains that the soil loses its cohesion (shear strength) and behaves as a liquid.

loading. Pertaining to the contribution of material or chemicals to a receiving stream.

loess. Wind blown soil deposits.

long term. A period greater than 35 years (i.e., postoperational).

macroinvertebrate. Small animals without backbones that are visible without a microscope, for example, insects, small crustaceans, and worms.

macronutrient. Elements necessary in large amounts for plant growth.

mainstem. The primary channel in a stream or river.

makeup water. Additional water required to supplement water lost during the milling process.

management area. Geographic areas, not necessarily contiguous, which have a common set of management requirements set by the KNF Forest Plan requirements and land allocations.

management situations. Areas of grizzly bear or mountain goat habitat, that due to their characteristics, have specific Forest Service management goals and directions.

mean. The average number of a set of values.

median. A numerical value in the midpoint of a range of values with half the value points above and half the points below.

mesic. Intermediate or moderate moisture or temperature; or reference to organisms adapted to moderate climates.

metric. A value calculated from existing data and used for summarization purposes.

microclimate. A small area influenced by its own weather patterns.

middleground. The viewed landscape from 0.8 to 4.8 km (0.5 to 3 mi.) from an observer.

mine dry. Changing room for employees.

mitigation. An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

moraine. A landform resulting from glacial deposition of material such as boulders, till, gravel, sand, and clay.

mycorrhizae. An association that develops when certain fungi and plant roots form a mutually beneficial relationship. One of the beneficial results is that mycorrhizae help plants absorb nutrients for soils.

neotropical migrant birds. Bird species that migrate to tropical areas such as Central or South America for the wintering months. Includes most of Montana's song birds.

nitrification/denitrification. A biological process for the conversion of ammonia compounds to nitrogen gas. The process is carried out in two steps. In the first step, nitrification, the ammonia compound is aerobically converted to nitrate by bacteria. In the second step, denitrification, nitrate is aerobically converted to nitrogen gas.

non-specular. Conductor treated in the factory to remove the sheen normally present on new conductors.

old growth areas managed by the KNF Plan. These areas are managed as management areas (MA-13). The goal of MA 13 is to maintain 10 percent on KNF lands below 5,500 feet within a major drainage in old growth condition (as described below under old growth ecosystems). The Forest Plan direction is to provide a diversity of types of old growth units located throughout a drainage, ranging in size from 100 to 1,200 acres, with occasional units as small as 50 acres.

old growth associated species. Those species that depend on habitat components normally found in old growth, such as large snags or large dead and down woody material, but that can survive in other age or size class forest stands if those habitat components are present.

old growth dependent species. Those species that can only survive in old growth habitats, or that need old growth for some critical portion of their life cycle.

old growth ecosystems. Old growth ecosystems can be defined by elements of structure, function, and composition. Structure includes large live and dead old-growth trees, and fallen dead trees on land and in streams. Function refers to the mechanisms and rates of ecological processes, including high primary productivity (photosynthesis), high respiratory rates relative to younger stands, a “shifting-mosaic steady state” (from Borman and Likens 1979, in Jerry 1983) of living biomass, and large accumulations of dead organic matter. Composition refers to the species of plants and animals present in old growth ecosystems, including old growth dependent or associated species (Jerry 1983, pp. 6-9).

overburden. Geologic material of any nature that overlies a deposit of ore or coal.

palliative. A substance that relieves the effects of a problem.

palustrine system wetland. Palustrine system wetlands are traditionally called marshes, swamps, bogs, or fens. They include all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below O.5 percent.

patio. The level area immediately outside the adit portal, built of fill to provide a work area, and access to the mine area.

peak flow. The greatest attained water flow in a specified period of time.

perched water table. An isolated saturated zone above an impermeable layer in an otherwise unsaturated soil or rock.

perennial stream. A stream that flows throughout the year, and from source to mouth.

period of record. The period of time over which data have been collected.

permeable. Allowing the passage of fluids.

phreatic surface. The boundary between saturated and unsaturated soil zone in an aquifer.

pillar. A column of rock retained for structural support in a mine.

piping. Creation of tunnels or cavities from the movement of water in soil.

plankton (ic). Aquatic animal and plant organisms that drift or float, unable to influence their own course, and ranging in size from microorganisms to jellyfish.

plasticity. A soil property indicating the degree to which a soil can be molded before breaking.

poaching. Illegal hunting, including hunting without a license or proper permit or hunting out of season.

population. A collection of individuals that share a common gene pool.

population viability. Probability that a population will persist for a specified period of time across its range despite normal fluctuations in population and environmental conditions.

portal. Surface entrance to a mine, particularly to a tunnel or adit.

pressure filtration. A water treatment system that uses a filter in conjunction with a pump.

probable maximum flood. The flood resulting from Probable Maximum Precipitation; the largest flood event theoretically possible.

quartzite. A granular metamorphic rock consisting essentially of quartz.

rain-on-snow event. A meteorological occurrence in the months of December through February during which the heat contained in rainfall melts the existing snow cover producing large amounts of runoff and high stream flows in a short time frame.

raise. Incremental increases in the height of a dam.

raptors. Birds of prey.

reach. An extended portion of river with uniform characteristics.

redd. A fish spawning nest.

regeneration. Regrowth of a tree crop, or other vegetation, whether by natural or artificial means.

replacement old growth. Older age class stands that have some of the characteristics of old growth but not all of them. Used for stands that are managed as old growth in compartments that lack the minimum amount of old growth.

return ponds. Storage ponds for water to be recycled to the tailings pond.

reverse osmosis. The normal osmosis process involves the flow of liquid across a semi-permeable membrane from a dilute concentration to a more concentrated solution until equilibrium is reached. Reverse osmosis is accomplished by application high pressure to the concentrated side causing the process to reverse. This results in an even higher concentration of solute. The nitrogen compounds involved in the reverse osmosis process are mainly in the ammonium or nitrate form.

rhizome. A vegetative species that spreads by shooting out underground stems. (Rhyzomatous.)

riparian. Areas with distinct resource values and characteristics that are comprised of an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and lake shores.

run-of-mill. Total material passing through a mill.

salmonid. Member of the fish family Salmonidae; includes salmon and trout.

scarify. To roughen the upper 1 to 2 inches of soil in preparation for seeding.

sedge. A grass-like plant, often associated with moist or wet environments.

sediment yield. The quantity of sediment delivered to a stream.

seepage collection system. The system of drains, ponds, and pumps to collect and return tailings dam embankment seepage.

segregation. The separation of water from sources of contamination in a mine.

seismic. Of, or produced by, earthquakes.

sensitive species. Those species, plant and animal identified by the Regional Forester for which population viability is a concern, as evidenced by: 1) significant current or predicted downwards trend in population numbers or density or 2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

seral stage. A developmental stage in the succession of plant communities. A seral community (or species) is replaced by another community (or species) as succession progresses.

seven-inch slump. A test to measure the consistency of concrete where a standard 12-inch test column of concrete slumps to 7 inches.

short term. A period of time less than 35 years (i.e., operational period).

side slope. The slope of an embankment or waste dump.

significant. See **Appendix A.**

siltite. A rock that has formed as a result of the hardening of sediments by pressure and heat. Siltite is harder than mudstone, and not as hard as shale. The rock is composed of particles generally larger than clay size and is made up of laminates thicker than argillite.

slump test. A test to measure the consistency of concrete while still wet (see seven-inch slump above).

slurry. A mixture of fine-grained solid material and water used to allow pumping as a way to transport the solid material over long distances.

slimes. A product of wet crushing consisting of wet particles that will pass a 200-mesh screen.

spalling. Rock breaking off in layers parallel to the surface.

stability. the ability of a population to remain at approximately the same population size over time through stable natality and mortality rates.

starter dam. Earthen dams built of borrow material to initiate construction of the tailings impoundment.

standard deviation. A parameter that indicates the way in which a probability function or probability density function is centered around its mean and that is equal to the square root of the moment in which the deviation from the mean is squared.

standpipe piezometer. A small well used to locate the water table.

stochastic. Random, uncertain; involving a random variable.

stope. Step-like underground excavation for removal of ore in successive layers.

stratabound. A mineral deposit confined to a single layer, bed or stratum.

stratum. A section of a formation that consists of primarily the same rock type.

study area. Study areas may refer to those identified in ASARCO's baseline studies or to those used for the environmental analysis. The size of study areas depends on the resource under consideration. For example, the area examined in ASARCO's 1984-1985 wildlife baseline study. The intensive study area, 25 square miles, primarily was comprised of the proposed permit area. The extensive study area, 125 square miles, extended beyond the permit area including adjacent lands. Most survey efforts were concentrated within the intensive study area.

subpopulation. A well-defined set of interacting individuals that comprise a portion of a larger, interbreeding population.

subsidence. The sudden sinking or gradual downward settling of the earth's surface with little or no horizontal motion.

sustainability. The ability of a population to maintain a relatively stable population size over time.

tackifier. An agent that binds seed, fertilizer, and mulch to a site, often used when seeding slopes.

tailings slurry decant. The liquid portion of the tailings slurry that remains after gravity settling in a tailings impoundment.

threatened. Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.

toe dam. A small dam located at the base of a larger embankment; usually to collect seepage or runoff.

total suspended solids. Undissolved particles suspended in liquid.

transect. A line, strip, or series of plots from which biological samples, such as vegetation, are taken.

trophic state. Position on food chain relative to other animals.

unconfined aquifer. An aquifer in which there are no confining beds between the water table and the surface.

unconsolidated. Loose or soft.

ungulate. A hoofed mammal, such as deer or elk.

upgradient. A direction characterized by higher fluid potential or hydraulic head.

variety class. A particular level of visual variety or diversity of landscape character.

A (distinctive). Refers to areas where landforms, vegetative patterns, water features, and rock formations are of unusual or outstanding visual quality and are not common in the character type.

B (common). Refers to areas where landscape features contain some variety but tend to be common throughout the character type.

C (minimal). Refers to areas where landscape features have very little variety and high uniformity in form, line, color, and texture.

viability. Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.

viewer sensitivity. The degree of viewer interest in the landscape's scenic quality.

Level 1 (high). At least 1/4 of users of primary travel routes, use areas, or water bodies, or at least 3/4 of users of secondary travel routes, use areas, or water bodies have major concern for scenic quality.

Level 2 (moderate). Less than 1/4 of users of primary travel routes or use areas, or between 1/4 and 3/4 of users of secondary travel routes or use areas have major concern for scenic quality.

Level 3 (low). Less than 1/4 of users of secondary travel routes or use areas have major concern for scenic quality.

viewshed. The portion of the surrounding landscape that is visible from a single observation point or set of points.

visual quality objective. A desired level of scenic quality based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape.

zone of influence. The area outside the physical workings of the mine and related facilities that is affected by noise, pollution, encroachment, or other disturbances caused by mining activities.

CHAPTER 9

REFERENCES CITED

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Able, Jr., J.F., and F.T. Lee. 1980. *Subsidence potential in shale and crystalline rocks.* Open-File Report 80-1072. U.S. Department of the Interior, Geological Survey.

Adamus, P.R., and R.T. Stockwell. 1983. *A method for wetland functional assessment; Vol I, Critical review and evaluation concepts.* Rep. FHWA-IP-82-23. Federal Highway Administration, U.S. Dept. of Transportation, Washington, D.C.

Agipito, J.F.T. and Associates, Inc. 1991. *Evaluation of subsidence potential Montanore Project, Noranda Minerals Corp.* Submitted to IMS, Inc., contractor to Montana Department of State Lands.

Ahlenslager, K. 1993. *Colville National Forest Sensitive Plant Handbook: 1993.* U. S. Forest Service, Colville National Forest, Colville, WA.

Allen, L. 1996. *Coeur d'Alene salamander habitat suitability model*. Model prepared for ASARCO Rock Creek Mine project.

Aney, W. and B.R. McCelland. *In* Warren, N. ed. 1990. (See Warren 1990)

Armiston, K.A. 1968. Soils, roots, and foresters. *In Proceedings of the 3rd North American Forest Soils Conference.* Corvallis:Oregon State University Press.

ASARCO, Incorporated. 1981-1994. Benthic macroinvertebrate monitoring program for streams adjacent to ASARCO's Troy, Montana unit. Completion reports for spring, summer, and fall. Typescript.

_____. 1987-1994. *Environmental baseline reports/application for a hard rock operating permit for the Rock Creek project, Sanders County, Montana.* Submitted by ASARCO, Incorporated to the Montana Department of State Lands and U.S. Forest Service, Kootenai National Forest. Permit Application Vols. 1, 2, and 2A. Baseline Reports Vols. 1, 2, and 2A.

_____. 1988. Unpublished information developed as part of the Hard Rock Impact Plan to be submitted to the Montana Department of Commerce Hard Rock Impact Board and Sanders County.

_____. 1990. *Petition for modification of ambient water quality, ASARCO Rock Creek Project.* Submitted to Department of Health and Environmental Sciences, Helena, MT. February 23, 1990.

_____. 1991. Appendum for Land Application Disposal Area. August 2.

_____. 1992. *ASARCO Rock Creek adit license application.* Submitted to Department of State Lands and Kootenai National Forest.

_____. 1993. *Wetlands inventory, consideration of alternatives, and mitigation plan.* Prepared by ASARCO, Incorporated with assistance from Western Technology and Engineering, Inc. and Hydrometrics, Inc. Helena, MT. March 1993.

_____. 1995. *Revised water management plan to support MPDES permit application ASARCO Rock Creek Project, Sanders County, Montana.* Prepared by Hydrometrics, Inc. Helena, MT. March 1995.

_____. 1996. *Hardrock Impact Plan, Rock Creek Project*. June 19, 1996 draft. Submitted by ASARCO, Inc. to Sanders and Lincoln Counties.

_____. 1997a. *ASARCO Rock Creek Project Hard-Rock Impact Plan*. June 18, 1997. Submitted by Economic Consultants Northwest, Helena, MT. 276 pps.

_____. 1997b. Preliminary Designs for Wetlands Mitigation, Alternative 5 - Paste Placement of Tailings, ASARCO Rock Creek Project. March 26.

_____. 1997c. Memorandum to Kathleen Johnson, MDEQ and Paul Kaiser, USFS. October 9.

Astle, R. and G.C. Knight. 1990. The underground disposal of mine waste. *In* Doyle, F.M. ed. *Mining and Mineral Processing Wastes, Proceedings of the Western Regional Symposium on Mining & Mineral Procession Wastes, Berkeley, California, May 30 - June 1, 1990.*

Baden, J.A. and T. O'Brien. 1994. Economics and ecosystems: Coevolution in the northwest. *illahee* 10(3):192-204.

_____. 1984. An ecological assessment of water quality in the Clark Fork River: Milltown to Huson, Montana. *Proc. Montana Acad. Sci.* 44:5-17.

Bahls, L. 1993. *Periphyton bioassessment methods for Montana streams.* Montana Department of Health and Environmental Sciences, Water Quality Bureau, Helena, MT.

Balla, J.C. 1984. Description of the Rock Creek deposit. Unpublished report for Forest Service use in Cur and Lynn lode mining claim validity investigation. Prepared by ASARCO, Incorporated. Typescript.

Banchi, V. *In* Butts, T. 1992. (See Butts 1992)

Bannister, D.P., R.D. Weldin, N.T. Zilka, and S.W. Schmauch. 1981. Economic appraisal of the Cabinet Mountains Wilderness, Lincoln and Sanders counties, Montana. *U.S. Geological Survey Bulletin* 1501-D

Barnard, D. and J. Vashro. 1986. *In* ASARCO, Incorporated. 1987-1994. (See ASARCO, Incorporated 1987-1994)

Batt, P. 1996. Governor Philip E. Batt's State of Idaho bull trout conservation plan. http://www.state.id.us/gov/pr/btcontnt.htm (October 15, 1997).

Beckwith, M. 1989. *Compilation of water quality study efforts on Lake Pend Oreille 1984-1988.* Idaho Department of Health and Welfare, Division of Environmental Quality, Water Quality Status Report No. 90, Boise.

Beebe, F.L. 1974. Field Studies of the Falconiformes of British Columbia (vultures, hawks, falcons, eagles)._ British Columbia Provincial Museum. No. 17 Occasional Paper Series, Victoria, BC. 163 pp (pg 62 cited).

Bergquist, June. 1994. Idaho Division of Environmental Quality letter to Kathy Johnson, Montana DEQ. July 15.

Berndt, H.W. and R.D. Gibbons. 1958. *Root distribution of some native trees and understory plants growing on three sites within ponderosa pine watersheds in Colorado.* Rocky Mountain Forest and Range Experiment Station. Research Paper No. 37. Fort Collins, CO.

Bigart, R., and C. Woodcock. 1996 *In the Name of the Salish and Kootenai Nation: The 1855 Hell Gate Treaty and the Origin of the Flathead Indian Reservation*. Salish Kootenai College Press, Pablo, Montana.

Bjornn, T.C., M.A. Brusvan, M.P. Molnau, J.H. Milligan, R.A. Klamt, E. Chaco, C. Schaye. 1977. *Transport of granitic sediment in streams and its effects on insects and fish.* Forest Wildlife Range Experiment Station Bulletin 17. University of Idaho, Moscow.

Bloomquist, L.E., and M.S. Killian. 1988. *Specialization is Tied to Natural Resources, People. Rural Development Perspectives.* 4(2): 34 -35.

Bratkovich, A. 1992. *Montanore project biological assessment for threatened and endangered species.* U.S. Department of Agriculture, Forest Service, Kootenai National Forest, Libby, MT.

British Columbia Acid Mine Drainage Task Force. 1989. *Draft acid rock drainage technical guide.* Prepared by Steppin, Robertson, and Kirsten (B.C.), Inc.

British Columbia Ministry of the Environment. 1983. *The effect on water quality of explosives use in surface mining; nitrogen sources, water quality, and prediction and management of impacts.* MOE Technical Report. May 1983.

Brusven, M.A. and K.V. Prather. 1974. Influence of stream sediments on distribution of macrobenthos. *J. Ent. Soc. Brit. Col.* 71:25-32.

Bukantis, B. 1996. Rapid bioassessment macroinvertebrate protocols: sampling and sample analysis SOP's. Working draft, 12 November 1996. Montana Department of Environmental Quality, Planning, Prevention and Assistance.

Bureau of Economic Analysis. 1992. County projections to 2040. U.S. Department of Commerce, Economic and Statistics Administration, Washington, D.C. Available from Montana Census and Economic Information Center, Helena, MT. Data diskettes.

_____. 1993. County economic information report (historic information), U.S. Department of Commerce, Economic and Statistics Administration, Washington, D.C. Available from the Montana Census and Economic Information Center, Helena, MT. Typescript.

Burke, __. *In* Warren, N. ed. 1990. *In* Warren, N. 1990. (See Warren 1990)

Burnett. J.A., B. J. Cosby, and J. M. Eilers. 1997. Overview, Libby Lake Modeling Workshop. E&S Environmental Chemistry. Covallis, Oregon.

Butts, T. 1992. *Wolverine (Gulo) biology and management: A literature review and annotated bibliography*. Prepared for U.S. Forest Service, Northern Region Threatened, Endangered, and Sensitive Program.

Camp, Dresser, & McKee Inc. 1989. *Final geotechnical engineering assessment for the ASARCO Rock Creek environmental impact statement (Scope of work deliverable nos. 42 through 46).* Prepared for Montana Department of State Lands, Hard Rock Bureau. Camp, Dresser & Mckee, Helena, MT. March 15, 1989.

Carriker, R.C. 1973. *The Kalispel People*. Indian Tribal Services, Phoenix.

Casebeer, R.L., M.J. Rognrud, and S. Brandborg. 1950. *Rocky mountain goat in Montana.* Montana fish and Game Commission, Pittman-Robertson Federal Aid Project Bulletin No. 5. *In* Joslin,G. 1980. *Mountain goat habitat management plan for the Cabinet Mountains, MT.* Montana Department of Fish, Wildlife and Parks, Helena, MT.

Cassirer, E., A. Breault, P. Clarkson, D. Genter, R. Coudie, B. Hunt, S. Latta, G. Mittelhauser, M. McCollough, G. Schirato, and R. Wallen. 1993. *Status of harlequin ducks (Histrionicus) in North America.* Report of the Harlequin Duck Working Group.

Cassirer E., and G. Grove *In* Cassirer et al. 1993. (See Cassirer et al. 1993)

Cassirer, E.F. and R. I. Goudie. 1995. *ASARCO DEIS comments.* Letter from Harlequin Duck Working Group, Lewiston, ID. 5 pp.

Cassirer, E.F., J.D. Reichel, R.I. Wallen, E.C. Atkison. 1996. *Harlequin Duck (Histrionicus histrionicus) conservation assessment and strategy for the U.S. Rocky Mountains.* Idaho Dept. of Fish and

Game, Montana Natural Heritage Program, Grand Teton National Park Office of Science and Resource Management, Hawk Mountain Sanctuary Association. 54 pp.

Caywood, J. M. 1986. *Intensive cultural resource inventory of ASARCO's proposed Rock Creek project area*. Prepared for ASARCO, Incorporated and submitted to Kootenai National Forest.

Chen-Northern. 1990. *Technical feasibility assessment, preliminary tailings impoundment design, ASARCO Rock Creek Project.* Prepared for Department of State Lands, Helena, MT. February, 1990.

Choquette, W. T. 1984. A proposed cultural chronology for the Kootenai Region. *In Cultural Resource Investigations of the Bonneville Power Administration's Libby Integration Project, Northern Idaho and Northwestern Montana.* Gough, S. ed. Eastern Washington University Reports in *Archaeology and History*, 100-20, Cheney.

Christensen, A. and M. Madel. 1982. *Cumulative effects analysis process grizzly habitat component mapping Kootenai National Forest.* U.S. Forest Service, Kootenai National Forest, Libby, MT.

Christensen, M., and M.F. Allen. 1980. *Effect of VA mycorrhizae on water stress tolerance and hormone balance in native western plant species.* Final report submitted to the Industrial Fund of Rocky Mountain Institute of Energy and Environment, College of Engineering, College of Arts and Sciences, University of Wyoming, Laramie.

Christiansen, A. and M.R. Kuennen. 1984. *Old growth habitat characteristics and management guidelines.* U.S. Forest Service, Kootenai National Forest, Libby, MT.

Clarkson, __. *In* Reichel, J. and D. Genter. 1995. (See Reichel and Genter 1995)

Copeland, J. P. 1996. Biology of the Wolverine in Central Idaho. University of Idaho, Masters Thesis. Moscow, Idaho.

Coppinger, K.D., P.R. Ogle and D. McGirr. 1993. Using organic matter to select optimum topsoil salvage depths: a strategy to improve topsoil quality and reduce salvage depths. *Paper presented at symposium, Planning, Rehabilitation and Treatment of Disturbed Lands*, 21-27 May, Billings, MT.

Cosby, B.J., R.F. Wright, G.M. Hornberger, and J.N. Galloway. 1985a. Modeling the Effects of Acid Deposition, Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistries. Water Resource Res. 21:51-63.

_____. 1985b. Time scales of Catchment Acidification: A Quantitative Model for Estimating Freshwater Acidification. Environ. Sci. Technol. 19:1144-1149.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of wetlands and deepwater habitats of the United States*. Performed for U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services. Washington, D.C. December.

Cox, C.S., R.C. McConnell, and L.M. Matthew. 1960. *Ponderosa pine productivity in relation to soil and landform in western Montana*. Bulletin No. 17, Montana Forest and Conservation Experiment Station, University of Montana, Missoula.

Cummins, K.W. and C.H. Lauff. 1969. The influence of substrate particle size in the microdistributions of stream macrobenthos. *Hydrobiology*. 71:25-32.

Dames & Moore. 1987. *Preliminary design study, tailings disposal system, Rock Creek Unit, Noxon, Montana*. Prepared for ASARCO, Incorporated. Dames & Moore, Salt Lake City, Utah.

_____. 1993. *ASARCO Inc. Rock Creek Project, preliminary design study tailings disposal system (December 1989) and revised alternative impoundment design (March 1993)*. Prepared for ASARCO, Incorporated.

Deavers, K. 1989. The reversal of the rural renaissance: A recent historical perspective. *Entrepreneurial Economy Review* 8(5):3-5.

Dorn, R.D. 1984. *Vascular plants of Montana*. Cheyenne: Mountain West Publishing.

Douglas, C. and M. Strickland *In* Ruggiero et al. 1994. (See Ruggiero et al. 1994)

Dozier, J. 1962. Coeur d' Alene Country: The Creation of the Coeur d' Alene Reservation in Northern Idaho. *Idaho Yesterdays*. 6(3): 2-7.

Earll, N.F., K.S. Stout, G.G. Griswold Jr., R.I. Smith, F.H. Kelly, D.J. Emblen, W.A. Vine, D.H. Dahlem. 1976. *Handbook for small mining enterprises*. Montana Bureau of Mines and Geology. Bulletin No. 99. March 1976.

Elliot, Joe. 1996. Letter to ASARCO August 12, 1996, 3 pages plus maps.

Elliott, J.C. and D. March. 1997. Review of literature. Bull trout and sediment. Rock Creek, Noxon, Montana. Prepared for ASARCO, Inc., Troy, MT.

Environmental Laboratory. 1987. *Corps of Engineers wetland delineation manual*. Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Erickson, A.W. 1987. In ASARCO, Incorporated 1987- 1994. An assessment of the Impact of the Rock Creek Mining Project on the Grizzly Bear Population in the Cabinet Mountains, Montana.

Ethnography of the Kootenai. 1941. American Anthropological Association, Memoirs, No. 56. Menasha, Wisconsin.

Fahselt, D. 1988. The dangers of transplanting as a conservation technique. *Natural Areas Journal*. 8:4(238-244).

Fairman, L. M., P. Hackley, G. Thomas. 1995. Draft Biological Evaluation for Sensitive Species: ASARCO Rock Creek Project. 70 pp.

Fairman, L. and G. Miller. 1990. *Results of the 1990 survey for harlequin ducks (Histrionicus) on the Kootenai National Forest, Montana and parts of the Lolo National Forest, Montana*. Montana Natural Heritage Program, Helena, MT.

Farmer, P., C. Farmer, and S. Heath. 1987. *In* ASARCO, Incorporated 1987-1994. (Volume 1 Air & Water Resource, Wildlife, Air, Soils, Water and Vegetation)

Farmer, P., and S. Heath. 1986. Wildlife Baseline Inventory Rock Creek Study Area. *In* ASARCO, Incorporated 1987-1994.

Federal Interagency Committee for Wetland Delineation. 1989. *Federal manual for identifying and delineation jurisdictional wetlands*. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and USDA Soil Conservation Service, Washington D.C. Cooperative technical publication.

Ferris, W. A. 1940. *Life in the Rocky Mountains*. Philips, P.C. ed. Denver:Far West Publishing.

Flath, D. 1984. *Vertebrate species of special interest or concern*. Montana Department of Fish, Wildlife and Parks, Helena, MT.

Fodor, Eben. 1996. The Three Myths of Growth. Planning Commissioners Journal 21 (winter): 18-21

Forsman, E.D., Lint, J.B., Menslow, E.C., Noon, B.R., Thomas, J.W., J. Verner. 1990. *A Conservation Strategy for the Northern Spotted Owl*. Interagency Scientific Committee to Address Conservation of the Northern Spotted Owl. Portland, Oregon.

Foster, B. 1987. *In* Joslin, G. 1986. (See Joslin 1986)

Fredlund, L. B. and D. Fredlund. 1990. *Cultural resource survey of water disposal sites for ASARCO's Rock Creek project*. Prepared for ASARCO, Incorporated by GCM Services, Inc.

Freudenburg, W. R. 1992. Addictive economies: Extractive industries and vulnerable localities in a changing world economy. *Rural Sociology* 57(3):305-332.

Freudenburg, W.R. and S. Frickel. 1994. Digging deeper: Mining dependent regions in historical perspective. *Rural Sociology* 59(2):266-288.

Freudenburg, W.R. and R.E. Jones. 1991. Criminal behavior and rapid community growth: Examining the evidence. *Rural Sociology* 56(4): 619-645.

Gaffney, J.J. 1955. *A survey of the fishery resource in a section of the Clark Fork River in western Montana.* Montana Fish and Game Department.

Gamon, J. 1992. Report on the status in Washington of *Howellia aquatilis Gray*. Washington Natural Heritage Program, Olympia, WA. Typescript.

Giest, V. 1975. *Harassment of large mammals and birds, with a critique of the research submitted by Arctic Gas Study Ltd. on this subject.* Report to the Berger Commission. Faculty of Environmental Design, University of Calgary, Alberta.

Glasgow, N. 1990. Attracting retirees as a community development option. *J. Community Development Society* 21(1):102-114.

Golden Sunlight Mines, Inc. 1995. Hard Rock Mining Permit Application and Plan of Operations for an Amendment to Operating Permit 00065. Volume 5, Appendix 5.5-2, pg 5-17, GSM, Whitehall, MT. August.

Golder Associates. 1996. Evaluation of Surface Paste Placement as an Alternative Tailings Management Technology. October.

Gordon, D. 1994. Translocation of species into conservation areas: A key for natural resource managers. *Natural Areas Journal.* 14(1):31-37.

Graham, P.J. 1981. *Status of white sturgeon in the Kootenai River*. Montana Department of Fish, Wildlife and Parks, Kalispell, MT.

Hall, L. 1987. Transplanting sensitive plants as a mitigation for environmental impacts. Elias, T. ed. *In Proc. of a symposium: Conservation and Management of Rare and Endangered Plants.* California Native Plant Society. Sacramento, CA.

Hamer, T. 1976. First annual eagle-osprey survey. Cabinet Ranger District, Kootenai National Forest, Trout Creek, MT. Typescript.

Hansen, B. S. 1990. Changes in the benthic community of Lake Creek, Montana, resulting from mine tailings contamination. *Proceedings of the 1990 Clark Fork River Symposium.*

Harger, R. 1978. Managing old growth forests as wildlife habitat: An ecosystem approach. *In* Warren, N. ed. 1990. (See Warren 1990)

Harley, J.L. 1969. *The biology of mycorrhiza.* London: Leonard Hill.

Harms, D. 1990. Summary of the interagency biologist meeting of February 22, 1990; grizzly bear standards and guidelines. U.S.Fish and Wildlife Service, Helena, MT. Meeting notes.

_____. 1994. Interagency memo concerning distribution of listed species on the Kootenai National Forest. U.S. Fish and Wildlife Service, Helena, MT.

Harris, L. 1984. *The fragmented forest.* Chicago:University of Chicago Press.

Harrison, J.E. 1972. Precambrian belt basin of northwestern United States: its geometry, sedimentation and copper occurrences. *Geological Society of America Bulletin* 83: 1,215-1,240.

Harrison, J.E., E.R. Cressman, and J.W. Whipple. 1992. Geologic and Structure Maps of the Kalispell 1° x 2° Quadrangle, Montana, and Alberta, and British Columbia.

Harrison, R.T. 1978. Predicting off-road vehicle acoustic impacts on recreation - a simplified method. Ither, R., D.R. Potter, J.K. Agee, and S. Anschell eds. *In Proceedings of the Conference on Recreation Impacts on Wildlands, Seattle, WA.* U.S. Forest Service Publication R-6-001-1979. Portland, OR. Oct. 27-29, 1978.

_____. 1985. *Sound levels from oil and gas exploration activities, Flathead National Forest , Glacier National Park and Helena National Forest.* Report EPA 908/1-85-001, by J.D. Foch, Jr. and R.E. Burke, Contract 68-01-6587 with EPA Region 8, Denver, CO. February, 1985.

Harrison, R.T., R.C. Clark, and G.H. Stankey. 1980. *Predicting impact of noise on recreationists.* Report 8023-1202, Equipment Development Center Project No. 2688. U.S. Forest Service, San Dimas, CA.

Harwood, M.E. and C.T. Youngberg. 1969. Soils from Mazama ash in Oregon: Identification, distribution and properties. Pawluk, S. ed. *In Pedology and quaternary research.* Alberta Institute of Pedology, Edmonton.

Hash, H. 1987. Wolverine. *In* Novak, M., J. Baker, M. Obbard, and B. Malloch eds. No date. *Wild furbearer management and conservation in North America.* Ontario Trappers Association, North Bay.

Hayes, T.S. 1983. Geologic studies on the genesis of the Spar Lake strata-bound copper-silver deposit, Lincoln County, Montana. Dissertation for Ph.D submitted to the Department of Applied Sciences, Stanford University, Stanford. November 1983. Typescript.

_____. 1986. Genesis of the Spar Lake stratabound copper-silver deposit, Montana: Part I controls inherited from sedimentation and preore diogenesis. *Economic Geology.* 81:1899-1931.

Heffner, B. 1991. Economic Development Division, Summary notes from *Montana's Economic Future presentation* of September 17, 1991. Economic Development Division, Montana Department of Commerce, Helena, Montana.

Heidel, B. 1997. Montana plant species of special concern. [Unpublished List.] Montana Natural Heritage Program, Helena. 34pp

Heinemeyer, K. 1993. Temporal dynamics in the movements, habitat use, activity, and spacing of reintroduced fishers in northwestern Montana. Masters of Science Thesis, University of Montana, Missoula. *In* Heinemeyer, K. and J. Jones 1994. (See Heinemeyer and Jones 1994)

_____. *In* Heinemeyer, K. and J. Jones. 1994. (See Heinemeyer and Jones 1994)

Heinemeyer, K. and J. Jones. 1994. *Fisher biology and management in the western United States: Literature review and adaptive management strategy.* Version 1.1. U.S. Forest Service, Northern Region and Interagency Forest Carnivore Working Group. Missoula, MT.

Hightower, T. and J. Vashro. 1987. *In* ASARCO, Incorporated 1987-1994. (See ASARCO, Incorporated 1987-1994)

Hightower, T.P. 1988. *Baseline fisheries inventory of selected streams within the Libby Creek watershed and upper Rock Creek drainage.* Montana Department of Fish, Wildlife and Parks, Kalispell, MT. Prepared for Noranda Minerals Corp., Reno, NV.

Hinz, __. *In* Butts, T. 1992. (See Butts 1992)

Hitchcock, C. L. and A. Cronquist. 1973. *Flora of the Pacific northwest.* Seattle: University of Washington Press.

Hitchcock, C.L., A. Cronquist, M. Ownby, and J.W. Thompson. 1955-1969. *Vascular Plants of the Pacific Northwest.* 5 vols. Seattle: University of Washington Press.

Hoelscher, B. 1993. *Pend Oreille Lake fishery assessment.* Water Quality Status Report No. 102. Idaho Dept. of Health and Welfare, Division of Environmental Quality, Boise, ID.

Hoelscher, B. and T.C. Bjornn. 1989. *Habitat, densities, and potential production of trout and char in Pend Orielle Lake tributaries.* Idaho Department of Fish and Game, Federal Aid in Fish Restoration, Project F-71-R-10, Job 8, Job Completion Report, Boise.

Hoffman, R. and D. Pattie. 1968. *A guide to Montana mammals: Identification, habitat, distribution and abundance.* University of Montana, Missoula.

Hudson, L., S. Boswell, C.D. Carley, W. Choquette, Christian Ms., D.H. Chance, and M. Stamper. 1981.

A Cultural Resource Overview for the Colville and Idaho Panhandle National Forests and the Bureau of Land Management - Spokane and Coeur d' Alene Districts Northeastern Washington/Northern Idaho Volume 1 Cultural Resource Narrative. Cultural Resource Consultants, Inc. Sandpoint, Idaho.

Humphrey, C.R. 1994. *Introduction: Natural Resource-Dependent Communities and Persistent Rural Poverty in the U.S.- Part II*. Society and Natural Resources 7(3):201 - 203.

Huston, J.E. 1985. *Thirty-two years of fish management Noxon Rapids and Cabinet Gorge reservoirs.* Montana Department Fish, Wildlife and Parks, Helena, MT.

_____. 1988. *Northwest Montana coldwater lakes investigations: Noxon Rapids and Cabinet Gorge reservoirs segment.* Montana Department of Fish, Wildlife and Parks. Statewide Fisheries Investigations, Project No. F-46-R-1-II-a.

_____. 1993. *Northwest Montana coldwater lakes investigations, Noxon Rapids and Cabinet Gorge Reservoirs segment.* Job Progress Report F-46-R-6, Job II-a. Montana Department of Fish, Wildlife and Parks, Fisheries Division.

Hutchison, I.P., and R.D. Ellison eds. 1992. *Mine waste management, a resource for mining industry professionals, regulators and consulting engineers*. Sponsored by California Mining Association. Chelsea, MI:Lewis Publishers, Inc.

Hydrometrics, Inc. 1986. *In* ASARCO, Incorporated. 1987-1994. (See ASARCO, Incorporated 1987-1994)

_____. 1989. 1988 annual report water resources baseline study for the Asarco Rock Creek Project. May 1989. Hydrometrics, Inc., Helena, MT.

_____. 1990. 1989 annual report water resources baseline study for the Asarco Rock Creek Project. March 1990. Hydrometrics, Inc., Helena, MT.

_____. 1992. 1990-1991 annual report water resources baseline study for the Asarco Rock Creek Project. June 1992. Hydrometrics, Inc., Helena, MT.

_____. 1997. Preliminary Completeness Response for the ASARCO Rock Creek Project Alternative 5 Water Management Plan. March. Hydrometrics, Inc., Helena, MT. Prepared for ASARCO Incorporated.

Interagency Grizzly Bear Committee. 1986. *Interagency grizzly bear guidelines.* U.S. Forest Service, U.S. Fish and Wildlife Service, Montana Department of Fish, Wildlife and Parks, Idaho Fish and Game, Wyoming Game and Fish, Bureau of Land Management, Washington Department of Wildlife, and National Park Service.

Interagency Grizzly Bear Committee. 1994. Taskforce Report: Motorized Access Management, 8pp.

Irving, D.B. 1986. *Pend Oreille trout and char life history study*. Idaho Department of Fish and Game, in cooperation with Lake Pend Oreille Club, Boise, ID.

Jacobson, S. 1997. *ASARCO Rock Creek Sensitive Species Biological Evaluation*. Report prepared for ASARCO Rock Creek Supplmental EIS.

Jacobson, S. L. 1997. Draft ASARCO Rock Creek Project Wildlife Mitigation Plan. 5 pp.

Jenkins, A., and M. Renshaw. 1995. Modeling of Acidification in Groundwaters in Catchments - with Aggregated Nitrogen Dynamics (MAGIC-WAND). R&D Note 468. Institute of Hydrology, Wallingford.

Jerry, D. G. 1983. Old Growth Management in the Idaho Panhandle National Forests. Idaho Panhandle National Forest Plan Appendix 28, Coeur d'Alene, ID. 39 pp.

Jobes, P.C. 1992. Economic development and quality of life decisions in migrating to a high natural amenity area. *In* Jobes P.C., W.F. Stinner, and J.M. Wardell eds. *Community, society and migration: Noneconomic migration in America.* New York:University Press of America.

Johns, C. and J. Moore. 1985. Copper, zinc, and arsenic in bottom sediments of Clark Fork River Reservoirs - preliminary findings. *Proceedings of the Clark Fork River Symposium*, Montana College of Mineral Science and Technology, Butte, Montana.

Johns, W.M. 1970. Geology and mineral deposits of Lincoln and Flathead counties, Montana. *Montana Bureau of Mines and Geology Bulletin* 79.

Johnsen, S. 1997. *Fisher Habitat Analysis on the Kootenai National Forest*. Report prepared for ASARCO Rock Creek EIS.

Johnsen, S. 1997. *Wolverine Habitat Analysis on the Kootenai National Forest*. Report prepared for ASARCO Rock Creek EIS.

Johnson, J.D. and R. Rasker. 1993. Local government:local business climate and quality of life. *Montana Policy Review* 3(2):11-9.

Johnson, S. 1997. *Fisher Habitat Analysis on the Kootenai National Forest.* Report prepared for ASARCO Rock Creek EIS.

_____. 1997. *Wolverine Habitat Analysis on the Kootenai National Forest.* Report prepared for ASARCO Rock Creek EIS.

Jones, J.P., B.B. Singh, M.A. Fosberg, and A.L. Falen. 1979. Physical, chemical, and morphological characteristics of soils from volcanic ash in Northern Idaho: II. Phosphorus sorption. *Soil Science Society American Journal* 43:547-552.

Jones, K. 1984. Memorandum to Dennis Hemmer, Gary Amestoy, Steve Anderson. Montana Department of State Lands, Helena, MT. June 26, 1984.

Joslin, G. 1980. *Mountain goat habitat management plan for the Cabinet Mountains, Montana.* Montana Department of Fish, Wildlife and Parks, Helena, MT.

_____. 1986. Mountain goat population changes in relation to energy exploration along Montana's Rocky Mountain Front. *Proc. of the fifth biennial symposium.* Northern Wild Sheep and Goat Council. Helena, MT.

Kabata-Pendias, A. and H. Pendias. 1984. *Trace elements in soils and plants.* Boca Raton:CRC Press, Inc.

Kasworm, W.F. and T.L. Manley. 1988. *Grizzly bear and black bear ecology in the Cabinet Mountains of Northwest Montana.* Montana Department of Fish, Wildlife and Parks. Helena, MT.

_____. 1994. *Road and trail influences on grizzly bears and black bears in northwestern Montana.* In. Conf. Bear Res. and Manage. 8:79-84.

Kasworm, W. F. and C. Servheen. 1994. Cabinet-Yaak Ecosystem 1993 Progress Report.

Kasworm, W. F. and C. Servheen. 1995. Cabinet-Yaak Ecosystem 1994 Progress Report.

Kasworm, W.F. and T.J. Thier. 1992. *Cabinet-Yaak ecosystem grizzly bear and black bear research 1991 progress report.* U.S. Fish and Wildlife Service Grizzly Bear Recovery Coordinator's Office. University of Montana, Missoula.

Kasworm, W. F. and W. Wakkinen. 1997. *Grizzly bear and Road Density Relationships in the Selkirk and Cabinet-Yaak Recovery Zone.*

Kettner, M.L. 1993. Cabinet Mountains Wilderness AQRV Plan. Masters thesis for Environmental Engineering, Montana Technical University, Butte, MT.

Klohn Leonoff. 1991. *ASARCO Rock Creek Project, Technical Evaluation of Preliminary Tailings Impoundment Design.* Prepared for Department of State Lands, Helena, MT. December, 1991.
_____. 1992. *Rock Creek Tailings Project, review update.* Prepared for Department of State Lands, Helena, MT. March 1992.

Klohn-Crippen. 1997. Review of Tailings and Acid Rock Drainage, ASARCO Rock Creek Project. Draft, September 22, 1997.

Knezek, B.D. and B.G. Ellis. 1980. *In* Davies, B.E. ed. *Applied soil trace elements.* London:John Wiley and Sons, Ltd.

Knight Piesold 1997. *Conceptual Design Report on Alternative Methods for Paste Deposition.* ASARCO Incorporated Proposed Tailings Storage Facility, Rock Creek Project, Near Noxon, Montana. Prepared for ASARCO Incorporated. May.

Koch, E. and C. Peterson. 1989. Amphibians and reptiles - A preliminary survey of the distribution of amphibians and reptiles in Yellowstone National Park. *In* Clark, T., A. Harvey, R. Dorn, D. Genter, and C. Groves eds. 1989. *Rare, sensitive, and threatened species of the greater Yellowstone ecosystem.* Northern Rockies conservation cooperative, Montana Natural Heritage Program, The Nature Conservancy, and Mountain West Environmental Services.

Koehler, G.M. 1990. *In* Ruggiero, et al. 1990. (See Ruggiero et al. 1990)

Koehler, G.M. and J.D. Brittell. 1990. Managing Spruce-fir habitat for lynx and snowshoe hares. Journal of Forestry 88:10-14. *In* Ruggiero et al. 1994.

Krannich, R.S. and A.E. Luloff. 1991. Problems of resource dependency in U.S. rural communities. *Progress in Rural Policy and Planning* 1(1):5-18.

Kuchel, C. 1977. Some aspects of the behavior and ecology of harlequin ducks breeding in Glacier National Park. Master's thesis, University of Montana, Missoula.

Kuennen, L. and M. Gerhardt. 1984. *Kootenai National Forest Area Land System Inventory.* Kootenai National Forest. Libby, MT.

Kuennen, L., G. Edson, and T.V. Tolle. 1979. Soil compaction due to timber harvest activities. *Soil, Air, and Water Note 79-3.* U.S. Forest Service, Northern Region. Missoula, MT.

Lacey, C.A., J.R. Lacey, P.K. Fay, J.M. Story, and D.L. Zamora. 1992. *Controlling knapweed on Montana rangeland.* Circular 311. Agricultural Extension Service, Montana State University, Bozeman.

Leary, R.F., F.W. Allendorf, and K.L. Knudsen. 1983. Consistently high meristic counts in natural hybrids between brook and bull trout. *Systematic Zoology* 32:369-376.

Leary, R.F., F.W. Allendorf, S.R. Phelps, and K.L. Knudsen. 1984. Introgression between westslope cutthroat and rainbow trout in the Clark Fork River drainage, Montana. Proc. Mont. Acad. Sci. 43:1-18.

Lemkuhl, J.F. and L.F. Ruggiero. 1991. Forest fragmentation and its potential effects on wildlife in the Pacific Northwest. *In Proceeding of a symposium on old growth Douglas-fir forests: Wildlife communities and habitat relationships, March 29-31, 1989, Portland, OR.* U.S. Forest Service General Technical Report. PNW-GTR-285.

Leavell, D. 1994. Draft threatened and endangered species assessment, Kootenai National Forest. Typescript.

Leavell, D. and J. Triepke. 1993. *Draft Recommended Sensitive Plant Survey Methodology on the Kootenai National Forest.* Kootenai National Forest, Libby, MT.

Lesica, P. and S. Shelly. 1991. Sensitive, threatened and endangered vascular plants of Montana. *Montana Natural Heritage Program, Occasional Publication No. 1.* Helena, Montana.

Maiolie, M.A. 1991. *Region I lowland lakes investigations.* Idaho Department of Fish and Game, Job Performance Report, F-71-r 14, Job No. 1-b.

Malloch, D.W., K.A. Pirozynski, and P.H. Raven. 1980. Ecological and evolutionary significance of mycorrhizal symbiosis in vascular plants. *Proc. of the National Academy of Sciences.* 77:2,113-2,118.

Malouf, C. 1982. A study of the prehistoric and historic sites along the lower Clark Fork River Valley, western Montana. *University of Montana Contributions to Anthropology* No. 7. Department of Anthropology, University of Montana, Missoula.

Mathieus, G. 1996. The 1996 forestry BMP audits. Final report. Forestry Best Management Practices Implementation Monitoring. Department of Natural Resources and Conservation, Forestry Division, Missoula, MT.

May, B. 1982. *Instream flow evaluation for selected streams in the Kootenai National forest of Montana.* Contract No. 53-0343-0-305. U.S. Forest Service, Missoula, MT.

McClelland, W.T. and M.A. Brusven. 1980. Effects of sedimentation on the behavior and distribution of riffle insects in a laboratory stream. *Aquatic Insects.* 2:161-169.

McClelland, B.R. 1977. Relationships between hole-nesting birds, forest snags, and decay in western larch-Douglas-fir forests of the northern Rocky Mountains. Ph.D dissertation, University of Montana, Missoula.

McCulloch, R.B. 1997. *Montana Mineral Exploration*. Mining Engineering 49(5-May):62-65.

McLean, F.T., and B.E. Gilbert. 1927. The relative aluminum tolerance of crop plants. *Soil Science* 24:163-1741.

McMaster, K.M. 1994. Interagency memo containing species list of threatened, endangered, and proposed species for Kootenai National Forest. U.S. Fish and Wildlife Service, Helena, MT. January 24, 1994.

McMaster, K.M. 1997. U.S. Fish and Wildlife Service. Letter to Robert Shrenk, Kootenai National Forest. August 15.

McMinn, R.G. 1963. Characteristics of Douglas-fir root systems. *Canadian Journal of Botany*. 41:105-122.

Megahan, W.F. and W.J. Kidd. 1972. Effects of logging and logging roads on erosion and sediment deposition from steep terrain. *Journal of Forestry*. 70:136-141.

Mercer, J.W. , D.C. Skipp, and D. Griffin. 1990. *Basics of pump-and-treat ground water remediation technology*. EPA-600/8-90/003. Robert S. Kerr Environmental Research Laboratory. Ada, OK.

Miller, R.M., and R.E. Cameron. 1976. Some effects on soil microbiota of topsoil storage during surface mining. *Fourth Symposium on Surface Mining Reclamation, Conference and Exposition*. II. Louisville, KY.

Miller, R. M. 1996. Geochemical comparison of two very similar strata-bound copper sulfide ore bodies in Northwestern Montana. Montana Department of Environmental Quality.

Montana Bald Eagle Working Group. 1994. *Montana bald eagle management plan*. MBEWG and Bureau of Land Management. Billings, MT.

_____. 1991. *Habitat Management Guide for Bald Eagles in Northwestern Montana*. Paige, C. ed. Billings, MT.

Montana Department of Fish, Wildlife, and Parks. 1989, 1991, and 1993. Statewide harvest survey. Bruce Sterling, Area Biologist. Thompson Falls, MT. Typescript.

Montana Department of Environmental Quality. 1996. Montana list of waterbodies in need of Total Maximum Daily Load development - 1996. Montana Department of Environmental Quality, Helena, MT.

Montana Department of Health and Environmental Sciences. 1985a. Champion International Frenchtown mill discharge permit, MT-000035. Data Report-Vol. 1. Helena, MT. *In* Priscu, J.C. 1989. *Assessment of nutrient and algal relationships in the lower Clark fork River and Lake Pend Orielle: Baseline conditions and potential impacts to the Rock Creek project*. Prepared for Camp, Dresser & McKee, Denver, CO.

_____. 1985b. Water quality data, Clark Fork River and Rock Creek. Typescript.

_____. 1988. *401 B report*. Water Quality Bureau, Helena, MT.

_____. 1993. Water quality data, Clark Fork River and Rock Creek. Water Quality Bureau, Helena, MT. Typescript.

_____. 1994a. *Montana water quality: The Montana 305(B) report.* June 1994.

_____. 1994b. *Montana water quality standards.* Circular WQB-7. July 15, 1994.

_____. 1995. Water quality data for ASARCO Troy project in Water Quality Division files. Typescript.

Montana Department of Natural Resources and Conservation. 1988. Water rights data base. Typescript.

Montana Department of State Lands. 1992. Forestry best management practices. Typescript.

Montana Department of State Lands, Kootenai National Forest. 1978. *Environmental Impact Statement, Draft, Troy project, ASARCO, Incorporated, Lincoln County, Montana.* Volume 1. Proposed plan of mining reclamation. *In* ASARCO, Incorporated. 1987 -1994. (See ASARCO, Incorporated 1987-1994)

Montana Natural Heritage Program. 1988, 1993, 1994, and 1995. Plant species of special concern. Montana Natural Heritage Program, Montana State Library, Helena, MT. Computer printout.

Moore, J.N., S.N. Luoma, D. Peters. 1991. Downstream effects of mine effluent on an intermontane riparian system. *Can. J. Fish. Aquat. Sci.* 48:222-232.

Moseley, R. and C. Groves. 1990. *Rare, threatened and endangered plants and animals of Idaho.* Natural Heritage Section, Idaho Department of Fish and Game, Boise, ID.

Munther, G.L., M. Diebert, M. Hillis. 1978. Some wildlife and fisheries habitat management concepts: Lolo National Forest. *In* U.S. Forest Service. 1987. (See U.S. Forest Service 1987)

National Academy of Sciences. 1977. *Guidelines for preparing environmental impact statements on noise.* Report of Working Group 69. Washington, D.C.

National Institute for Occupational Safety and Health. 1978. *Health and safety guide for oil and gas well drilling and servicing.* NIOSH-78-190, U. S. Department of Health, Education and Welfare, Public Health Service, Cincinnati, OH.

National Oceanic and Atmospheric Administration. 1987. *Climatological data annual summary - Montana 1986.* Asheville, NC. 89:13.

Nauen, C.E. 1983. Completion of legal limits for hazardous substances in fish and fishery products. Food and Agriculture Organization of the United Nations. Circular No. 746. Rome, Italy. *In* Hoelscher, B. 1993. *Pend Orielle Lake fishery assessment.* Water Quality Status Report No. 102. Idaho Department of Health and Welfare, Division of Environmental Quality, Boise, ID.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. *North Am. J. Fish. Manage.* 11:72-82.

Nicholson, S.A. 1992. Montana's budget crisis and fiscal reform. *Montana Business Quarterly* 30(2):21-25.

Nimlos, T.J. 1981. *Volcanic ash soils of Montana.* Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula. Bulletin 45.

Noel, D. 1986. *In* ASARCO, Incorporated. 1987-1994. Baseline Soils Report.

Noranda Minerals Corp. 1989. *Application for a hard rock operating permit and proposed plan of operations for the Montana Project, Lincoln and Sanders counties, Montana.* Submitted to Montana Department of State Lands and Kootenai National Forest. 2 vols.

Nord, M. and A.E. Luloff. 1993. Socioeconomic heterogeneity of mining-development communities. *Rural Sociology* 58(3):492-500.

Northwest Policy Center, with US Bank. 1995. *The 1995 portrait: Regional economic review and outlook.* Northwest Policy Center, University of Washington, Seattle, WA.

NPA DATA Services, Inc. 1993. 1993 regional economic projection series (REPS), computerized data files issued by NPA DATA Services, Inc., Washington, D.C.

Nussbaum, R.A., E. D. Brodie, Jr., R. M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. University of Idaho Press, Moscow, ID. 332 pp.

Nuttall, P.M. and G.H. Bielby. 1973. The effect of china-clay wastes on stream invertebrates. *Env. Poll.* 5:77-86.

Ollendorf, Miller and Lehman. 1981. *Suggested practices for raptor protection on power lines.* Raptor Research Rep. No. 4. Raptor Research Foundation, Inc., Department of Veterinary Biology, University of Minnesota, St. Paul.

Omang, R.J., Parrett, C., and Hull, J.A. 1986. *Methods for estimating magnitude and frequency of floods in Montana based on data through 1983.* U.S. Geological Survey, Water-Resources Investigations Report 86-4027.

Packer, P.E. 1966. Forest treatment effects on water quality. *In International Symposium on Forest Hydrology. Proceedings of a National Science Foundation Advanced Science Seminar held at Pennsylvania State University.* New York:Pergamonm Press.

Parametrix, Inc. 1994. Comprehensive water quality monitoring program for streams adjacent to Asarco's Troy, Montana, unit: analyses of March 1986 through October 1996 samples. Final draft annual

report - Year Twelve. Prepared for Asarco Incorporated, Montana Department of State Lands, and Montana Department of Health and Environmental Sciences. Parametrix, Inc., Kirkland, WA.

Parker, C. 1987. *In* ASARCO, Incorporated. 1987-1994. (See ASARCO, Incorporated 1987-1994)

_____. 1996. *Rock Creek Sound Pressure Level Measurements.* Report to ASARCO, Inc.

Partridge, F. 1983. *Kootenai River fisheries investigations in Idaho.* Idaho Dept. Fish and Game, Boise, ID.

Perkinson, R.D. 1991. *Kootenai National Forest sensitive fish conservation assessment, draft.* U.S. Forest Service, Kootenai National Forest, Libby, MT.

Pfister, R., B. Kovalchik, S. Arno, and R. Presby. 1979. *Forest habitat types of Montana.* U.S. Forest Service, General Technical Report INT-34. Intermountain forest and Range Experiment Station, Ogden, UT.

Phelps, D.E., B. Jamieson, and R.A. Demarchi. 1975. *Mountain goat management in the Kootenays. I. The history of goat management II. A goat management plan, 1975-1985.* Fish and Wildlife Branch, Court House, Cranbrook, B.C.

Philips, G.R. and R.C. Russo. 1978. *Metal accumulation in fishes and aquatic invertebrates: A literature review.* Environmental Research Laboratory, Duluth, MN. EPA-600/778-103.

Phillips, G. and R. Spoon. 1990. Ambient toxicity assessments of Clark Fork River water toxicity test and metals residues in brown trout organs. Watson, V. ed. *In Proc. 1990 Clark Fork River Symposium.* University of Montana, Missoula.

Powell, R. *In* Ruggiero, et al. 1990. (See Ruggiero et al. 1990)

Power, T.J. 1989. Avoiding the passive/helpless approach to economic development. *Forest Watch* 10(Oct.):16-18.

_____. 1992. Economics Department, University of Montana, quoted in "Economist: Past a Roadblock to Prosperity". *Great Falls Tribune*. October 8, 1992.

Pratt, K.L. and J.E. Huston. 1993. *Status of bull trout (Salvelinus confluentus) in Lake Pend Oreille and the lower Clark Fork River: DRAFT.* Prepared for Washington Water Power Company, Spokane, WA.

Priscu, J.C. 1989. *Assessment of nutrient and algal relationships in the lower Clark Fork River and Lake Pend Oreille: Baseline conditions and potential impacts of the Rock Creek project.* Prepared for the Montana Department of Environmental Quality. February.

Rasker, R. 1992. Dynamic economy versus static policy in the greater Yellowstone ecosystem. *In* C. Payne, J. M. Bowler, and P.C. Reed (compilers). *The economic value of wilderness.* U.S. Forest Service Southeastern Forest Experiment Station General Technical Report SE - 78, Ashville, N.C.

Reckow, K.K. 1988. Empirical models for trophic state in southeastern U.S. lakes and reservoirs. *Water Resources Bulletin* 24:723-734. *In* Priscu, J. C. 1989. *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.* Prepared for Camp, Dresser, and McKee, Denver, CO.

Redpath Engineering. 1991. *Supplemental information in support of the environmental impact statement.* Prepared for Noranda Minerals Corp.

Reed, P.B., Jr. 1988a. *National list of plant species that occur in wetlands: national summary.* U.S. Fish and Wildlife Service, Washington, D.C. Biological Report 88(24).

Reed, P.B., Jr. 1988b. *National list of plant species that occur in wetlands: Montana.* U.S. Fish and Wildlife Service, Washington, D.C. Biological Report NERC-88/18.26.

Reel, S., L. Schassberger, and W. Ruediger. 1989. *Caring for our natural community: Region 1 threatened, endangered, and sensitive species program.* U.S. Forest Service, Northern Region, Missoula, MT.

Reeves, F.B., D. Wagner, T. Moorman, and J. Kiel. 1979. The role of endomycorrhaizaek in revegetation practices in the semi-arid west: I. A comparison of incidence of mycorrhizae in severely disturbed v.s. natural environments. *American Journal of Botany.* 66(1):6-13.

Reichel, J.D. 1995. *Literature review and summary of research priorities for Harlequin Ducks. Montana Natural Heritage Program.* Helena, MT. 37 pp.

Reichel, J. D. 1996. *Literature review and summary of research priorities for Harlequin Ducks. Montana Natural Heritage Program*. Helena, MT. 37 pp.

Reichel, J. and D. Genter. 1995. *Harlequin duck surveys in western Montana 1994.* Montana Natural Heritage Program, Helena, MT. January 1995.

Reichel, J. D., P. Hendricks, and D. L. Genter. 1997. Harlequin duck research and monitoring in Montana: 1996. Montana Natural Heritage Program. Helena, MT. 77 pp.

Rice, L.A. and T.A. Benson. 1984. *Rocky Mountain goat population status in the Black Hills, South Dakota, 1983-1994.* Department of Game, Fish, and Parks, Pierre, SD.

Rice, P.M., C.A. Lacey, J.R. Lacey, and R. Johnson. 1991. *Sulfur cinquefoil: Biology, ecology, and management in pasture and rangeland.* Montana State University Extension Service EB 109. Bozeman.

Rieman, B.E. and B. Bowler. 1980. *Kokanee trophic ecology and limnology in Pend Oreille Lake.* Idaho Department of Fish and Game, Fisheries Bulletin No. 1, Boise, ID.

Rieman, B.E. and J.D. McIntyre. 1993. *Demographic and habitat requirements for conservation of bull trout.* USDA Int.Mtn. Res. Sta. GTR INT-302.

Riggs, H.C. 1968. Mean stream flows from discharge measurements. Preliminary USGS report. Typescript.

Rodman, C. W. 1987. Acceptability criteria and measurement standards for areas which are reserved for activities requiring low sound levels. *In* J. Tichy and S. Hayak (eds), *Noise-Con 87 Proc., National Conference on Noise Control Engineering*, Pennsylvania State University, State College.

Roll, T. E. 1982. *Kootenai Canyon archeology: The 1979 LAURD project final mitigation report*. Submitted to Seattle District, U.S. Army Corps of Engineers.

Rosenberg, K. and M. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests. Verner, J., M. Morrison, and C. Ralph. eds. *In Wildlife 2000: Modelling habitat relationships of terrestrial vertebrates.* Madison:University of Wisconsin Press.

Roy, K.D. 1991. Ecology of reintroduced fishers in the Cabinet Mountains of northwestern Montana. Master's thesis, University of Montana, Missoula. *In* Heinemeyer, K. and J. Jones. 1994. (See Heinemeyer and Jones 1994)

Roy, K.D. 1991. Ecology of introduced fishers in the Cabinet Mountains of northwest Montana. Missoula, MT: University of Montana. Master's thesis, 94 pp *in* Ruggiero et al. 1994.

Ruggiero, L., K. Aubry, S. Buskirk, L.J. Lyon, W.J. Zielinski. eds. 1994. *The scientific basis for conserving forest carnivores: American marten, fisher, lynx and wolverine in the western United States*. General Technical Report RM-254. U.S. Forest Service, Rocky Mountain forest and Range Experiment Station, Fort Collins, CO. September 1994.

Schwab, D. and S. A. Aaberg. 1993. *Results of subsurface cultural resource site discovery techniques: ASARCO Rock Creek mine project, Sanders County, Montana.* Report prepared for ASARCO, Incorporated by Aaberg Cultural Resource Consulting Service, Bozeman, MT.

Scow, K., L.D. Culwell, and L. Larsen. 1987. *In* ASARCO, Incorporated. 1987-1994. Vegetation Inventory of the Rock Creek Study Area, Sanders County, Montana.

Setter, A. and E. Brannon. 1990. *Report on Kootenai River white sturgeon electrophoretic studies, 1989.* Aquaculture Extension, University of Idaho, Moscow.

Shelly, J.S. and R. Moseley. 1988. Report on the conservation status of *Howellia aquatilis*, a candidate threatened species. Montana Natural Heritage Program, Helena, MT. Typescript.

Simon, Julian. 1981. *The Ultimate Resource*. Princeton: Princeton University Press (cited in Freudenburg 1992).

Sinai, A. 1990. Services Economic Highlights. *The Service Economy Coalition of Service Industries* 4(4):6-17.

Slaney, P.A., T.A. Halsey, and A.F. Tautz. 1977. *Effects of forest harvesting practices on spawning habitats of stream salmonids in the Centennial Creek watershed.* British Columbia Ministry of Environment, Fisheries Management Report 73, Fish and Wildlife Branch, Vancouver, B.C. *In* Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. *North Am. J. Fish. Manage.* 11:72-82.

Smith, A.H. 1984. *Kootenai Indian Subsistence and Settlement Patterns Northwest Montana*. US Army Corps of Engineers Under Contract No. DACW67-81-C-0100 and DACW67-83-M-0522.

Smith, D.M. 1962. *The practice of silviculture.* 7th Edition. New York:John Wiley and Sons.

Smith, R.W. 1994. *Tributary survey lower Clark Fork River drainage. Progress report: Rock Creek, West Fork Rock Creek.* Washington Water Power Company, Spokane, WA.

Smith, R.N. 1993. Proposed endangered status for the Kootenai River population of the white sturgeon. U.S. Fish and Wildlife Service. *Federal Register* 58(128):36379-87.

Sohn, S. W. 1992. Chief Economist, Norwest Corporation, presentation to Great Falls business gathering, February 12, 1992, *Great Falls Tribune.* As reported on February 13, 1992.

Soutiere, E.C. 1979. Effects of timber harvesting on marten in Maine. *In* Warren, E. ed. 1990. (See Warren 1990)

Stark N. and S. Baker. 1992. *Ecology and culture of Montana huckleberries.* Montana Forest and Conservation Experiment Station, University of Montana, Missoula.

Sterling, B. 1994. Memorandum from Bruce Sterling, Montana Department of Fish Wildlife and Parks to Lisa Fairman. June 15.

Stolen, P. D. 1980. *Northern Border Pipeline: Climate, air quality, and ambient sound environment.* Report prepared for Montana Department of Natural Resources and Conservation. Helena, MT.

Story, M. T., 1997. ASARCO Rock Creek Mine Project, Libby Lakes -- MAGIC/WAND Modelling, Kootenai National Forest. February 25.

Summerfield, B. 1995. Memorandum from Bob Summerfield, KNF to Lisa Fairman. March 10.

Swanson, L. D. 1991. The shifting place of trade in Montana: Patterns of growth and location of retail and services trade. *Montana Business Quarterly* 29(2):2-11.

_____. 1992a. The region's changing economic landscape: Urban/rural trends during the 1980's. *Montana Business Quarterly* 30(3):2-12.

_____. 1992b. Regional resource industry dependency. *Montana Business Quarterly* 30(1):16-26.

_____. 1992c. Economist, Montana Bureau of Business and Economic Research, as reported in *"State Eases Dependence on Natural Resources"*. Jan. 31, 1992, *Great Falls Tribune.*

Sykora, J.L., E.J. Smith, and M. Synak. 1972. Effect of lime neutralized iron hydroxide suspensions on juvenile brook trout (*Salvelinus fontinalis Mitchell*). *Water Research* 6:935-950. *In* Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. *North Am. J. Fish. Manage.* 11:72-82.

Taylor, Bryan, II. 1996. "Global Financial Data" collected from George F. Warren and Frank A. Pearson. 1937. World Prices and the Building Industry, N.Y. John Wiley and Sons, and the Commodity Research Bureau, Commodity Yearbook (multiple dates), Chicago, Ill.

Thomas, G. 1992. *Status report: bull trout in Montana.* Prepared for Montana Department of Fish, Wildlife and Parks, Helena, MT.

Tiet, J. A. 1930. *The Salishan tribes of the western plateaus, edited by Franz Boas*. Bureau of American Ethnology, Annual Report 45, Washington, D.C. pp.23-396.

Thomas, J.W. ed. 1979. *Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington.* U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. September 1979.

Thompson, D. 1950. *The Journals of David Thompson.* White, C. ed. Montana State University Studies, No. 1, Missoula.

Thompson, R.J. 1989. Draft evaluation of alternative disposal sites and disposal methods for the ASARCO Rock Creek Project. Kootenai National Forest, Libby, MT. November 22, 1989. Typescript.

Trappe, J.M. 1981. Mycorrhizae and productivity of arid and semiarid rangelands. *In Advances in food producing systems for arid and semiarid lands.* New York: Academic Press, Inc.

TRC Environmental Consultants, Inc. *In* ASARCO, Incorporated. 1987-1994. (See ASARCO, Incorporated 1987-1994)

_____. 1995. Addendum to Air Quality Modelling Analysis for the ASARCO Rock Creek Project. August.

_____. 1997. Technical Support Document and Modelling Analysis. ASARCO Rock Creek Project. May.

Turney-High. 1937. *The Flathead Indians of Montana*. American Anthropological Association, Memoirs, No. 48. Menasha, Wisconsin.

U.S. Army Corps of Engineers. 1978. Libby additional units and reregulation dam, Design Memorandum No. 7; Reregulating dam basis of design, Appendix C of Design earthquake for Libby reregulating dam. Seattle District.

U.S. Bureau of Census. 1991. Census block data from the 1990 census. Typescript.

_____. 1993. Census data.

_____. 1995. Estimates of Montana's resident population: Counties. Released January 18, 1995.

U.S. Bureau of Land Management. 1986. *AMOCO Beartooth well exploration project environmental assessment.* Prepared for Bureau of Land Management, Miles City, MT. by Dames and Moore, Ft. Collins, CO.

U.S. Bureau of Mines. 1993. Metal Prices in the United States Through 1991, U.S. Bureau of Mines. Washington, D.C.

U.S. Department of Agriculture, Soil Conservation Service. 1985. *Hydric soils of the United States*. USDA-SCS National Bulletin No. 430-5-9, Washington, D.C.

U.S. Environmental Protection Agency. 1974. *Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety*. EPA Report 550/9-74-004. Washington, D.C.

_____. 1979. *Protective noise levels.* EPA Report 550/9-79-100. Washington, D.C.

_____. 1985. *Leachate plume management.* Office of Solid Waste and Emergency Response, Washington D.C. EPA/540/2-85/004.

_____. 1986. *Quality criteria for water.* Office of Regulations and Standards. EPA 440/5-86-001.

_____. 1988. *Guidance on remedial actions for contaminated ground water at Superfund sites.* Washington, D.C. EPA/540/G-88/003.

Clark Fork - Pend Oreille Basin Water Quality Study; A Summary of Findings and a Management Plan.

U.S. Fish and Wildlife Service. 1982. *Grizzly bear recovery plan.* CO.

_____. 1983. Revised list of Montana animal and plant candidates for listing under the Endangered

_____. 1984. *American peregrine falcon recovery plan (Rocky Mountain/southwest populations).*

Service, Denver, CO.

_____. 1986. U.S. Fish and Wildlife Service, Denver, CO.

_____. 1987. U.S. Fish and Wildlife Service, Denver, CO. January 2.

Grizzly bear recovery plan: Second review draft. Missoula, MT.

_____. 1993a. Plant taxa for listing as endangered or threatened species; Notice of review. 50 CFR Part 17. September 30, 1993.

Grizzly bear recovery plan. Missoula, MT.

aquatilis), determined to be a threatened species. *Federal Register*

_____. 1995. Montana animal and plant candidates for listing under the Endangered Species Act. Montana Field Office, Helena, MT. Typescript.

food and animal feed. FDA/IAS Booklet, updated March 1994. U.S. Food and Drug Administration, Washington, D.C.

Soil survey: St. Regis-Ninemile area, Montana. U.S. Forest Service, Northern

_____. 1974. The visual management system. Vol. 2, Chapter 1 of *National Forest landscape* Agriculture Handbook 462. Washington, D.C.: U.S. Government Printing Office, 1974.

The 1986 ROS book. U.S. Department of Agriculture, Forest Service.

_____. No date. *Soil and water conservation practices.* Forest Service Handbook SSH 2509.22.

_____. 1988. *Cumulative effects analysis process for the Cabinet/Yaak grizzly bear ecosystems 1988.* U.S. Forest Service, Idaho Game and Fish, Washington Department of Wildlife, Montana Department of Fish, Wildlife and Parks, U.S. Fish and Wildlife Service.

_____. 1991a. Threatened, Endangered and Sensitive Plants and Animals. FSM 2670.5

_____. 1991b. Updated Northern Region sensitive species list. Memo from John Mumma to Forest Supervisors. Typescript.

_____. 1995a. Inland Native Fish Strategy Environmental Assessment. U.S. Department of Agriculture, Forest Service, Intermountain, Northern, and Pacific Regions.

_____. 1995b. Landscape aesthetics: a handbook for scenery management. Agriculture Handbook Number 701.

U.S. Forest Service, Kootenai National Forest 1986. *Cabinet Mountains mineral activity coordination report.* Kootenai National Forest, Libby, MT. February, 1986.

_____. 1987. *Kootenai National Forest plan.* Northern Region, Missoula, MT. 3 vols. September 1987.

_____. 1988. Stand prognosis data base inquiry, U.S. Forest Service, Cabinet Ranger District. Trout Creek, MT. November 10, 1988. Typescript.

_____. 1993. Sensitive plants on the Kootenai. Typescript.

_____. 1994. Cabinet Ranger District timber stand data base. Computer printout.

_____. 1995a. Bird checklist.

_____. 1995b. Kootenai Forest Sensitive Plant Field Guide. Fourth Edition. Libby, MT. March.

_____. 1997. *Lynx conservation strategy.* Taskforce Chair: W. Johnson.

_____. 1997b. GIS database at Kootenai National Forest.

U.S. Forest Service, Montana Department of State Lands, Montana Department of Health and Environmental Sciences, and Montana Department of Natural Resources and Conservation. 1992. *Final environmental impact statement, Noranda Minerals Corp. Montana Reserves Company Joint Venture, Montanore Project.* October 1992.

U.S. Geological Survey (USGS) 1979. Streamflow characteristics of the Upper Columbia River Basin, Montana through 1979. Typescript.

_____. 1988. Clark Fork River flow data. Computer printout.

Voedehnal, G.L. 1993. The use of composted municipal waste to revegetate a high elevation mine site. Master's thesis, Montana State University, Bozeman.

Wallen, R. 1989. Habitat utilization by harlequin ducks in Grand Teton National Park. Master's thesis, Montana State University, Bozeman.

Ward, R. and C. Krebs. *In* Ruggiero et al. 1994. (See Ruggiero et al. 1994)

Warren, N. ed. 1990. *Old-growth habitats and associated wildlife species in the northern Rocky Mountains*. Northern Region Wildlife Habitat Relationships Program. U.S. Forest Service, Northern Region, Missoula, MT.

Washington Water Power. 1996. Lower Clark Fork River tributary survey. Final Report. Washington Water Power Company, Spokane, WA. Two volumes.

Watershed Consulting. 1997. 1996 Field data summary report for Rock Creek near Noxon, Montana. Final. Prepared for ASARCO Inc., Troy, MT. Watershed Consulting, Polson, MT.

Watson, V. 1988. *Control of nuisance algae in the Clark Fork River*. Prepared for Montana Department of Health and Environmental Sciences, Helena, MT.

Weaver, J. 1993. *Lynx, wolverine, and fisher in the western United States.* Research assessment and agenda for the interagency lynx-wolverine-fisher working group. Northern Rockies Conservation Cooperative, Missoula, MT.

Weaver, T.M. and J.J. Fraley. 1991. *Flathead Basin forest practices water quality fisheries cooperative program: fisheries habitat and fish populations*. Flathead Basin Commission, Kalispell, MT.

_____. 1993. A method to measure emergence success of westslope cutthroat trout fry from varying substrate compositions in a natural stream channel. *N. Am. J. Fish. Manage.* 13:817-822.

Webb, M., H. Ruber, and G. Leduc. 1976. The toxicity of various mining flotation reagents to rainbow trout (*Salmo gairdneri*). *Water Research* 10:303-306.

Wenner, L.N. 1992. *Minerals, people and dollars: Social, economic and technological aspects of mineral resource development.* USDA Forest Service, Northern Region, RI-92-133, Missoula, MT.

WESTECH. 1993. Evaluation of sensitive plant species for the Rock Creek Project. Prepared for ASARCO, Inc. Helena, Montana. Typescript.

White, M. J. 1990. *Cultural resource inventory of late group drill holes.* Report prepared for the Kootenai National Forest.

Wilber, C.G. 1983. *Turbidity in the aquatic environment.* Springfield:Charles C. Thomas.

Wilcove, D.S., C.H. McClellan, and A.P. Dobson. *In* Warren, N. ed. 1990. (See Warren 1990)

Wilcox, B.A. 1984. In situ conservation of genetic resources: Determinants of minimum area requirements. *In* Wilson, E.O. 1988. (See Wilson 1988)

Wilson, A. E. 1990. *Cultural resource inventory of the Hydrometrics, Inc., Rock Creek monitoring wells.* Prepared for U.S. Forest Service, Kootenai National Forest, Libby, MT.

_____. 1992. *Cultural resource inventory of the East Fork Rock Creek Road.* Report prepared for U.S. Forest Service, Kootenai National Forest, Libby, MT.

Wilson, E.O. ed. 1988. *Biodiversity*. Washington, D.C:National Academy Press.

Woody, F. W. 1896. A sketch of the early history of western Montana. *Contributions of the Montana Historical Society* 2:105.

Workman, D. 1985. Trout populations in the Clark Fork River, Warm Springs to Superior, Montana. *Proceedings of the Clark Fork River Symposium*. Montana College of Mineral Science and Technology, Butte, Montana.

Wright, D. and B. Solero. 1973. *Limnology of Yellowtail Reservoir and Bighorn River*. Water Pollution Control Research Series. Environmental Protection Agency, Washington, D.C.

Young, D.J. 1992. Montana taxation and expenditures: Trends and comparisons. *Montana Business Quarterly* 30(3):13-20.

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APPENDIX

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APPENDIX B

DRAFT BIOLOGICAL ASSESSMENT

APPENDIX B

DRAFT BIOLOGICAL ASSESSMENT

BULL TROUT SECTION

ASARCO Incorporated - Rock Creek Mine Project

BULL TROUT

Description of Population and Habitat Status

I. *Management Goals*

The Columbia River population segment of bull trout was recently proposed by U.S. Fish and Wildlife Service for threatened listing under the Endangered Species Act (62 FR 32268). This species will continue to be managed as a sensitive species until such time as the proposed rule becomes final. The Kootenai National Forest Land and Resource Management Plan (Forest Plan) contains no goals or objectives with regard to the management of sensitive fish species. The Forest Plan sets out two standards: The management and identification of sensitive species will be in accordance with state-of-the-art information (Vol. 1, pp. ii-25) and [the Forest will] determine the status of sensitive species, and provide for their needs as necessary to prevent them from being listed as threatened or endangered (Vol. 1, pp. ii-l). The intent of the latter standard is still applicable even though some of the wording has been made moot given the proposed listing.

The Kootenai National Forest has developed a draft sensitive fish species conservation plan. This plan has not been signed and is unofficial. Copies of the plan are available from the Kootenai National Forest Supervisors Office. Currently, inland native fish in the Kootenai National Forest are managed according to the Inland Native Fish Strategy (INFISH). This strategy is intended to provide interim direction for forest management on 22 National Forests, including the Kootenai National Forest. This guidance may be superseded upon completion of the Environmental Impact Statement being prepared for the Interior Columbia Basin Ecosystem Management Project (Forest Service/BLM 1997). The purpose of INFISH is to maintain options for native fish by reducing the risk of loss of populations and reducing potential negative impacts to aquatic habitat. Below is a summary of the INFISH strategy.

INFISH includes eight riparian goals that establish the characteristics of health, functioning watersheds, riparian areas, and associated fish habitats. Also included in INFISH are interim riparian management objectives that are indicators of ecosystem health, are quantifiable, and are subject to accurate, repeatable measurements. An example of an interim riparian conservation objective would be no measurable increase in maximum water temperature.

In order to reach the goals of INFISH, standards and guidelines are outlined which apply to riparian habitat conservation areas (RHCAs) and to projects and activities in areas outside RHCAs that would degrade RHCAs. There are four categories of RHCA. For the purposes of this project analysis, RHCAs will be defined in the following manner: Category 1 - fish bearing streams with 300-foot slope distance on both sides of the stream channel; Category 2 - permanently flowing non-fish-bearing streams with 150-foot slope distance on both sides of the stream channel; Category 3 - ponds, lakes, reservoirs, and wetlands greater than l acre with 150-foot slope distance from the edge of the wetland (Note: There are no ponds, lakes, or reservoirs in the ASARCO/Rock Creek project area. There are, however, wetlands greater than 1 acre.); and Category 4 - seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide prone areas with 100-foot slope distance from the edge of the area. Figure TD1 shows the RHCAs for the project area.

The degree to which the ASARCO/Rock Creek project complies with INFISH standards and guidelines is presented in the analysis of direct, indirect, and cumulative effects section below.

II. *Occurrence*

Distribution
Bull trout are distributed throughout mainstem Rock Creek, the West Fork Rock Creek, and the East Fork Rock Creek. A waterfall on the West Fork Rock Creek, located approximately 1.9 miles upstream of the confluence with the East Fork (see Figure TD2), appears to be the upper limit of fish distribution in this drainage (Barnard and Vashro 1986). The upper limit of bull trout distribution in East Fork Rock Creek appears to be a waterfall located approximately 0.6 miles above the Rock Lake Trail bridge (R. Smith, Washington Water Power Co., Noxon, Montana, personal communication, July 6, 1995). Bull trout have been found in the East Fork at a sampling site downstream of this waterfall, but have not been found in Rock Creek Meadows (approximately 3.5 miles upstream from the confluence with the West Fork Rock Creek) (Hightower 1988).

Engle Creek and Orr Creek have been sampled by Montana Fish, Wildlife, and Parks and no bull trout were found. Engle Creek contains primarily brook trout and a few cutthroat trout. Orr Creek contains pure strain westslope cutthroat trout (Huston 1994). Snort Creek was electrofished in 1985 and no fish were found (Barnard and Vashro 1986). None of the other tributaries to Rock Creek have been sampled for fish. Most of these streams flow intermittently with steep gradients that are unlikely to support bull trout.

Abundance
Baseline fisheries data have been collected at various locations on Rock Creek through the use of electrofishing surveys (Figure TD2). Results for these surveys are presented in Table TD1.

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). Young-of-year bull trout were sampled as far upstream as the EF4 sampling reach, suggesting that the previous year's spawning occurred upstream of the site (Watershed Consulting 1997). (Young-of-year fish can not move upstream in this tributary.) A likely limiting factor for fish in this drainage is the three intermittent stream segments, RC-1, RC-4, and WF-1. Spawning by resident bull trout has not been confirmed, but data collected by Watershed Consulting (1997)(i.e., possible redds, bull trout in spawning condition, and young-of-year fish) indicate spawning has occurred.

Rock Creek may support both resident and migratory bull trout. In West Fork Rock Creek, 1-to-3-year-old bull trout have been found upstream of the potential fish passage barrier. This barrier has been estimated to be in place for at least 2 to 3 years, potentially indicating a resident, isolated population of bull trout in upper West Fork Rock Creek (Smith, pers. comm., March 3, 1993). 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).

There is evidence of bull trout migration from Cabinet Gorge Reservoir into Rock Creek, presumably for spawning. Hightower and Vashro (*In* ASARCO, Incorporated 1987-1994) collected a 27-inch bull trout that appeared to be from Cabinet Gorge Reservoir at section RC-2. Other large bull trout have also been documented in Rock Creek (Joe Huston, Department of Fish, Wildlife and Parks, personal communication, March 9, 1995 and May 1982). Although a small number of large bull trout which presumably migrated from Cabinet Gorge Reservoir have been observed in Rock Creek, spawning by

TABLE TD1. Bull Trout Density Estimates in Rock Creek, 1985-1996

Section (Date Sampled)	Source	# Fish/100 sq. ft.	Percent of all fish that were bull trout	Other species present
RC-1 (8/4/86)	2	0.08	9	Ct, Br
RC-2 (10/30/93)	4	0.04	2	Ct, Br
RC-2 (8/5/86)	2	0.09	5	Ct, Br
RC-2 (7/22/85)	1	0.03	1	Ct, Br
RC-4 (8/8/86)	2	0.08	23	Ct, Br
RC-4 (8/7/85)	1	0.07	18	Ct
WF-1[a] (11/19/93)	4	1.2	57	Ct
WF-2[a] (11/19/93)	4	1.1	60	Ct
WF-3[a] (11/19/93)	4	1.1	57	Ct
WF-1[b] (11/19/93)	4	0.22	76	Ct
WF-1 (7/31/86)	2	0.19	70	Ct
WF-1 (7/25/85)	1	0.34	82	Ct
EF-1 (10/30/93)	4	0.44	19	Ct
EF-1 1988	3	0.40	31	Ct
EF-1 (8/7/86)	2	0.99	30	Ct
EF-1 (8/22/85)	1	0.30	25	Ct
MS3 (8/29/96)	5 [c]	0.11	8	Ct, Br
EF1 (9/9/96)	5 [c]	0.22	18	Ct
EF2 (9/10/96)	5 [c]	0.41	18	Ct
EF3 (9/10/96)	5 [c]	0.39	24	Ct
EF4 (9/11/96)	5 [c]	0.72	42	Ct
EF5 (9/11/96)	5 [c]	0.41	26	Ct
EF6 (9/12/96)	5 [c]	0.13	9	Ct

Sources: 1=Barnard and Vashro 1986; 2=Hightower and Vashro 1987; 3=Hightower 1988; 4=WWP 1996; 5=Watershed Consulting 1997.
Ct = Westslope cutthroat trout, Br = Brook trout

[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) different from all locations sampled previously; population estimates recalculated by excluding fish < 75 mm in length to be consistent with reporting conventions of other sampling events

these individuals in Rock Creek has not been documented. WWP (1996) indicated that the flows at the mouth of Rock Creek in recent years have been insufficient to allow upstream passage of fall-spawning bull trout from the reservoir.

III. *Habitat Condition - 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. During baseline studies, the average hardness of water in Rock Creek was about 10 mg/L. Overall productivity of the stream is low. 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 some metals have occasionally exceeded numeric water quality standards. This is due to extremely low hardness. (Water quality criteria for many metals are proportional to water hardness). No metal toxicity to aquatic life has been documented in Rock Creek.

Mainstem Rock Creek has an average gradient of 5.2 percent (WWP 1996). Several sections of the mainstem have intermittent streamflow. Substrate in the lower reaches is comprised of high amounts of gravel (WWP 1996). 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 (WWP 1996)

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 TD2). The mean percentage of sediment less than 0.25 inch in diameter was not significantly different ($p > 0.05$) from 1988-1991 at station RC-2. The overall mean and median percentage for the four years of data was 28.1 and 24.8 percent, respectively (Table TD2). The overall mean percentage from station RC-2 was significantly less ($p < 0.05$) than the mean percentage (41.8 percent) determined from samples collected by WWP (1996) from a reach which includes river both above and below the confluence of Engle Creek. Weaver and Fraley (1991 and 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 (Weaver and Fraley 1991, 1993). Therefore, survival to emergence in the portion of Rock Creek downstream of Engle Creek is predicted to range from 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.

Surface fines in sediment (less than 0.25 inch diameter) were also measured in mainstream Rock Creek by WWP (1996) 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 analyzed 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 1996). In 1996, the percentages ranged from 0 to 22.6 over eight stations, with a mean of 10 percent (Watershed Consulting 1997).

TABLE TD2.
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 East and West Forks of Rock Creek; sampled by WWP (1996); samples collected downstream of confluence with Engle Creek (Smith 1994)

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

East Fork Rock Creek begins at Rock Lake. 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. There is a low gradient section in Rock Creek Meadows, below Rock Lake (Farmer et al. 1986).

The East Fork contains considerable amounts of large woody debris. The substrate consists primarily of large cobble and boulders with relatively little bedload movement. The percentage of surface fines averages 1 percent (Watershed Consulting 1997). Stream banks are stable with some channel braiding. Spawning habitat is limited to pockets of gravel behind stable debris or boulders (WWP 1996).

West Fork Rock Creek's gradient is highly variable, but averages 7.3 percent. It has a generally closed coniferous overstory and shrub understory along its entire length (Farmer et al. 1986). Stream banks are stable with some channel braiding. The entire lower reach (0.4 miles) of the West Fork is intermittent, as is 21 percent of the middle reach (0.4 miles) (WWP 1996).

The West Fork 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 (Smith, pers. comm., March 3, 1994). 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 TD3), which were statistically indistinguishable from each other ($p > 0.05$). Based on the median percent fines value for the two stations combined (26.5 percent), survival to emergence in West Fork Rock Creek is predicted to be 38 percent for bull trout.

TABLE TD3.
Percentage of West Fork Rock Creek Sediments[1] Less than 0.25 Inch Diameter

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 WWP (1996)
[3] = reach 2 extends from RM 0.4 to RM 0.6; sampled by WWP (1996)

Analysis of Direct, Indirect, and Cumulative Effects

I. *East Fork Rock Creek*

Under the preferred alternative, the mill site would be located at the confluence of the West Fork and the East Fork of Rock Creek. Approximately one-half mile of the downstream end of the East Fork Rock Creek could be impacted by the mill site. Upstream of the millsite no impacts to bull trout are anticipated.

The portions of the East Fork Rock Creek that parallel the mill site may be adversely affected. Construction activities may temporarily increase sediment loading and waste rock used in construction of the mill site may temporarily increase nutrient loading in this portion of the East Fork. In the unlikely event that a spill occurring at the mill site reaches the East Fork, impacts to bull trout may occur. A 300-foot buffer strip will separate the mill site from the East Fork Rock Creek, limiting impacts.

Overall, impacts to the East Fork Rock Creek are expected to be limited in area to a small portion of the stream and limited in duration to the construction and early operational periods unless an accident occurs. An accident could occur at any time during the construction, operation, or reclamation period.

II. *West Fork Rock Creek*

Potential impacts to the portions of the West Fork Rock Creek that parallel the mill site are similar to the East Fork Rock Creek except that the access road, pipelines, and utilities will cross the West Fork on a new (replacement) bridge located just upstream of the confluence. Bridge construction could result in minor, short term impacts to water quality in the lower West Fork Rock Creek. A spill could occur in the vicinity of the

bridge that could impact water quality and bull trout in the lower West Fork and mainstem Rock Creek. For more information about the potential impact from spills see mainstem Rock Creek (below). A 300-foot buffer zone between the mill site and the West Fork Rock Creek will afford partial protection to the aquatic life in the West Fork Rock Creek.

Upstream of the mill site, the West Fork Rock Creek could be affected by improvement of the exploration adit access road (FDR nos. 150, 2741, and a short spur road), construction of the exploration adit patio and waste rock dump or spills from the 6-inch discharge line from the exploration adit. However, sediment impacts from the exploration adit access road should be minor as no new construction is proposed and the road width will be narrow (approximately 14 feet). The exploration adit patio and waste rock dump will disturb 8.3 acres high in the West Fork Rock Creek drainage.

A 6-inch discharge line will transport mine adit water from the exploration adit to the mill site. In the event of a spill, untreated mine adit discharge water could reach the West Fork Rock Creek. The impact of such a spill can not be predicted as it depends on variables such as the quantity and quality of water spilled, location of the spill, response time for clean up, and the quantity of water in the creek. ASARCO has committed to installing leak detection equipment on this pipeline, which should reduce the chance of a spill reaching the creek.

Other than in the event of a major spill, impacts to the West Fork Rock Creek should be minor and/or short duration.

III. *Rock Creek*

Spills and impoundment failure
Spills of fuels, tailings, concentrate, or reagents could occur which would have toxic effects on bull trout if the toxins reached the water. Under the preferred alternative, truck hauling of concentrate from the mill to the rail loadout facility would be replaced by pipeline transport. The slurry pipeline, water reclaim line, discharge pipeline, or concentrate pipeline could leak or break, potentially spilling their contents into Rock Creek. ASARCO has committed to installing leak detection equipment on all pipelines, which should reduce the chance of a spill reaching the creek. The impacts to bull trout from accidental spills could be minor to major and potentially significant depending on the type of material spilled, the quantity that reached the water, the streamflow and water quality at the time of the spill, and a number of other variables. Factors which increase the risk of an accident occurring or the impacts of an accident include the material being transported, the weather, the proximity of the pipeline system to the stream, the effectiveness of the spill containment response, the frequency and thoroughness of pipeline maintenance and inspection, and other variables.

The deposited tailings paste would have a limited water content (20 percent), binding agent would not be added. Best management practices would be used to minimize migration of tailings to Rock Creek or any of its tributaries.

Sediment

Road construction and logging for roads, pipelines, and powerlines could potentially increase the percentage of fine sediments in Rock Creek. ASARCO has committed to use best management practices (BMPs) when constructing roads and logging. However, BMPs may not eliminate all sediment production (Mathieus 1996). An audit of the implementation and effectiveness of forestry BMPs (which included road construction) conducted in Montana in 1996 found that overall compliance with BMPs was high (92 percent of the practices rated on all sites were applied correctly and in the proper locations). High risk BMPs (those BMPs that are most important for protecting watersheds) were applied less consistently on Federal lands - 85 percent met or exceeded minimum requirements. On federal lands, 83 percent of the sites examined had minor departures from BMP application guidelines, while 33 percent had major departures. The effectiveness of BMPs was also less than perfect. On federal lands, 84 percent of the high risk BMPs provided adequate protection for the watershed, 9 percent had minor or temporary impacts, and 7 percent had major and temporary or minor and prolonged impacts. Since 1990, when the BMP audit program in Montana began, the effectiveness and application rate of BMPs has increased steadily (Mathieus 1996). However, in view of the most recent audit results (Mathieus 1996), it is unreasonable to assume that all sediment impacts will be eliminated through the use of BMPs. Specific BMPs to be used for the project will be identified in the Plan of Operations. If on-site audits of BMPs identify shortcomings in application or effectiveness of any BMPs, immediate corrections will be made and mitigations employed as necessary.

Current sediment sources in the Rock Creek watershed include: a large colluvial slump in the West Fork Rock Creek, accelerated bank (terrace) erosion in the mainstem Rock Creek, and the Engle Creek tributary (Watershed Consulting 1997). Sediment sources from the project include: roads associated with the tailings pond, the soil stockpile site, the access road, the tailings line corridor, emergency impoundments, and the exploration mine entry patio and waste rock dump. In order to offset unavoidable impacts from the mine, ASARCO will be responsible for mitigating sediment sources within the Rock Creek and Bull River watersheds on Forest Service lands equivalent to 74 acres of disturbed land. This acreage is the sum of the amount disturbed by roads associated with the tailings pond, the soil stockpile site, the access road, the tailings line corridor, emergency impoundments, and the exploration mine entry patio and waste rock dump. Sediment source reduction activities shall be completed during the construction period. These mitigations are a component of the preferred alternative being considered for approval by the agencies.

The disturbed soil created by construction activities would provide favorable sites for spotted knapweed, St. Johnswort, Canada thistle, and other noxious weeds. The spread of weeds is unavoidable. Noxious weed seed would likely be spread by vehicles moving from infested areas to newly disturbed areas along roads and utility corridors. ASARCO has committed to developing an effective weed management plan in cooperation with the Sanders County Weed Board, and the Agencies. Runoff and sediment yield are higher on knapweed infested lands (Lacey et al. 1992). The spread of noxious weeds may contribute to sediment loading in Rock Creek.

In spite of mitigation activities, additional sediment is likely to enter Rock Creek as a result of the ASARCO Rock Creek project. The amount of sediment that will be produced can not be predicted with accuracy as it will depend on variables such as weather conditions, effectiveness of BMPs, geology and soil types, effectiveness of sediment source reduction activities, etc. Most of the impact is likely to occur during the

three-year construction period. Impacts should decrease over time as newly disturbed areas stabilize and revegetate and stream flows flush sediment from the stream.

The impact of deposited sediment is difficult to quantify because it is not possible to accurately predict the amount of sediment that could be deposited on the stream bottom. Fine sediments deposited in gravels adversely affect reproductive success for bull trout. Very little spawning habitat is available in Rock Creek, and available spawning gravel in mainstem Rock Creek already contains a relatively high level of fine sediment. Any increase in deposited sediment in these spawning substrates would further reduce survival to emergence and potentially lead to reduction of fish populations due to reproductive failure. Rieman and McIntyre (1993) state that in the absence of detailed local information on population habitat dynamics, any increase in the proportion of fines in substrates should be considered a risk to the productivity of an environment and to the persistence of associated bull trout populations.

The change in Rock Creek sediment loading attributable to the project was estimated using the Forest Service model R1-WATSED. This model predicted that annual sediment yield in the entire Rock Creek watershed during the initial stages of the project would be 30 percent greater than existing conditions. At the end of the life of the mine, annual sediment yield is predicted to be 11 percent lower than existing conditions.

Bull trout in Rock Creek feed primarily on aquatic macroinvertebrates. The distribution of aquatic macroinvertebrates inhabiting running water environments is highly dependent on substrate particle size (Cummins and Lauf 1969). Increased levels of deposited sediment could reduce the quantity of aquatic macroinvertebrates, the food base for bull trout, in Rock Creek. Reduced food base could result in slower growth rates, higher mortality, and reduced fecundity of bull trout.

To the limited degree that adfluvial bull trout are present in Rock Creek, increases in deposited sediment in Rock Creek could impact the Cabinet Gorge Reservoir population. Adfluvial bull trout populations in the Cabinet Gorge Reservoir/lower Clark Fork River ecosystem are low and are at a very high risk of extirpation (Thomas 1992).

Nutrients

Waste rock may potentially contain residual nitrogen compounds from blasting. Leaching of soluble nitrogen in waste rock may cause a short term increase in nitrogen loading in Rock Creek. The impact of increased nitrogen loading on bull trout can not be accurately predicted.

Indirect effects

Habitat degradation could result in brook trout gaining a competitive advantage over bull trout. Brook trout interbreed with bull trout and the offspring are sterile. It is generally believed that such a mating is detrimental to bull trout populations.

Cumulative effects

Forest Service timber sales in the Rock Creek drainage concurrent with mining could have an effect on the timing and magnitude of runoff events, thereby increasing sediment, erosion, and channel instability. Logging activities in the Bull River drainage have the potential to impact the migratory bull trout in Cabinet Gorge Reservoir. Current and planned Forest Service timber sales in the drainage include the Lost Girl and Berray Mountain sales. The Lost Girl timber sale is located high in the watershed and buffer strips around water bodies will be relatively wide. Sediment impacts, if any, to the Bull River drainage from this sale should be minor (T. Nygaard, U.S. Forest Service, Cabinet Ranger District, Montana). The Berray Mountain sale will be helicopter logged. Road reconstruction will total less than one mile. A collapsing bridge over the Bull River will be removed in conjunction with this sale which should reduce the imminent risks to the Bull River posed by the wash out of the footings of this bridge. Overall sediment impacts from this sale should be a net reduction in sediment loading to the Bull River (T. Nygaard, U.S. Forest Service, Cabinet Ranger District, Montana).

The Forest Service is currently working on a watershed rehabilitation program in the Dry Creek drainage to reduce erosion, remove old roads, and eliminate washed out road crossings. During the initial phase of the project, conducted in 1994, approximately 10 miles of roads were removed (T.J. Kline, U.S. Forest Service, Cabinet Ranger District, pers. comm. with Tad Deshler, December 2, 1997). Reassessment of the area should occur in 1999. This program should result in a net decrease in sediment loading to the Bull River drainage.

ASARCO is logging a portion of their land along the Bull River and in the Rock Creek drainage, adjacent to mainstem Rock Creek. Potential impacts of logging could include reduced channel stability, increased sediment in the stream substrate, elevated water temperatures, and changes in the magnitude and timing of peak runoff events. The degree of impact will depend on the logging prescription, width of buffer strips, and the implementation and effectiveness of BMPs.

Both Noxon Rapids and Cabinet Gorge Dams are currently undergoing relicensing. One possible mitigation measure that is currently under discussion is the construction of a fish passage facility to allow fish passage to and from Lake Pend Oreille. A specific proposal has not been put forth, so it is impossible to accurately predict the impacts of a fish passage facility. The facility could potentially improve the status of bull trout by reversing the trend of habitat fragmentation initiated by the construction of the dams.

IV. *Compliance with INFISH Standards and Guidelines*

The ASARCO/Rock Creek project is in compliance with INFISH standards and guidelines except where noted below. Standard MM-2 specifies that adverse impacts to riparian zones and fish from the construction of roads and facilities should be avoided. It is likely that some sediment would be deposited in mainstem Rock Creek from construction activities within the riparian zone. Because sediment fines are already relatively high in Rock Creek spawning gravels, increased sediment loading could adversely affect inland native fish. Specific mitigations proposed as part of the road construction design could satisfy the overall goals and objectives of INFISH even if this specific standard was not met.

Portions of FDR No. 150 (an existing road) are within the RHCA for Rock Creek. The project proposal is to reconstruct the lower portion of this road (to be called Rd. 150B) around the south end of the paste impoundment to a single-lane 14-foot paved road with turnouts suitable for truck traffic. That part of the

road between the paste plant and FDR No. 150 will surfaced with aggregate material which includes dust abatement compounds. Road 150B is within the RHCA for an approximate distance of 0.3 mile. FDR No. 150 will be constructed/reconstructed to a paved, 2-lane road. FDR No. 150 is within the RHCA for a distance of approximately 0.2 mile. Paving FDR No. 150 would have a beneficial impact by lowering sediment production.

The exploration adit support facility will be located outside of the RHCA. This facility will be 1.3 acres in size. The project as a whole will affect 6.2 acres of wetlands.

V. *Population Viability Analysis*

The population viability analysis in this biological assessment follows the principles outlined in Ruggiero et al. (1994b). The authors described six general considerations for use as guidelines when making judgments about effects. Each of these guidelines is discussed below for the Lower Clark Fork/Cabinet Gorge Reservoir/Rock Creek/Bull River metapopulation of bull trout. This metapopulation is part of the larger bull trout population proposed for listing (62 FR 32268).

Principle #1: "Connected is better than disjointed."

A collection of interacting populations, linked through dispersal, is known as a metapopulation (Ruggiero et al. 1994b). The characteristics of bull trout populations are consistent with the metapopulation concept (Rieman and McIntyre 1993). An isolated population has little chance of being refounded after a local extinction compared to a subpopulation close to other subpopulations. As populations become isolated, local extinctions become permanent and the entire metapopulation moves incrementally toward extinction (Rieman and McIntyre 1993). Pratt and Huston (1993) state that the adfluvial stocks in Lake Pend Oreille, the Pend Oreille River basin, and the lower Clark Fork River were once part of a larger metapopulation. There were historically no barriers to fish movement, so genetic interchange was possible. Euro-american settlement and development fragmented the metapopulation by modifying habitats. At the present time, bull trout in Cabinet Gorge Reservoir are isolated from Lake Pend Oreille by Cabinet Gorge Dam and from upper portions of the Clark Fork River by Noxon Rapids Dam. Although downstream fish passage may be possible through these facilities, upstream fish passage is completely blocked. Bull trout in Rock Creek are isolated from Cabinet Gorge Reservoir during some seasons as a result of intermittency. Overall, fragmentation of the lower Clark Fork/Pend Oreille bull trout metapopulation has been extreme.

Principle #2: "Closer is better than farther."

The distance between suitable habitat and the nature of the intervening habitat influences the persistence of target species. In order to maintain demographic linkages, suitable habitat must be within a species' dispersal capabilities (Ruggiero et al. 1994b). While the actual distance between bull trout habitats in the lower Clark Fork drainage is quite small, the nature of the barriers between suitable habitats make the barriers difficult to overcome. Specifically, hydroelectric facilities are complete upstream fish passage barriers, although downstream fish passage is possible. Dewatered stream channels are complete seasonal barriers to dispersal in both an upstream and downstream direction. In summary, bull trout in the lower Clark Fork drainage experience serious impediments to movement which limit the population's dispersal capabilities.

Principle #3: "Older is often more valuable than younger."

As a result of habitat alterations, early successional vegetation has increased at the expense of late successional plant communities. Conservation concerns are increasingly focused on species closely associated with late successional vegetation (Ruggiero et al. 1994b), although research relating bull trout habitat needs to late successional vegetative communities has not been done.

Sections in the lower reaches of Rock Creek were logged and burnt-off in wildfires during the 1900s (Smith 1994). Most large cedars along the mainstem and the East and West Forks were harvested long ago and have been replaced by a dense canopy of hemlock, younger cedars, and other seral species (Farmer et a1. 1986). Stream intermittency and logged/burned sections along the mainstem appear to be related (Smith 1994). The presence and configuration of large rooted stumps in the present stream channel also indicates that the current channel configuration and seasonal flow patterns may not be the same as those that existed prior to logging and/or wildfire occurrence (Smith 1994). Pratt and Huston (1993) also noted that many historically perennial tributaries to the Clark Fork River became intermittent after logging or fires early in the development of the basin. They state that Rock Creek became intermittent in the 1960s. Pratt (pers. comm., March 27, 1995) believes that disturbances in the watershed, often the result of human activities, promote intermittency which is a major cause of continuing bull trout habitat loss. She states that intermittency is a primary deterrent to bull trout recovery in the lower Clark Fork River tributaries of Montana and Idaho.

Timber harvesting, either partial cutting or clearcutting, has occurred on 22 percent of the lands in the Rock Creek drainage. Another l0 percent has been commercially thinned. Approximately 47 miles of roads occur in a drainage area of about 33 square miles. Fine sediments in spawning gravel in mainstem Rock Creek are at levels associated with reduced survival to emergence of bull trout fry (see section on habitat condition). In summary, riparian zone logging and fires have contributed to a decline in bull trout habitat quality in the Rock Creek drainage, and in other drainages utilized, both in the past and present, by the lower Clark Fork bull trout metapopulation.

Principle #4: "Bigger is better than smaller."

Large habitat areas are important for maintaining biological diversity, supporting large population sizes, reducing the risk of extinction, and reducing the influence of negative edge effects (Ruggiero et al. 1994b). Research by Rieman and McIntyre (1995) suggests that patch size (habitat area) influences the occurrence of bull trout. They found that the probability of observing bull trout was directly correlated to patch size.

During the pre-contact period there were no barriers to impede the movement of bull trout between Lake Pend Oreille and the upper Clark Fork and Flathead River drainages. At the present time, bull trout are confined to Cabinet Gorge Reservoir and its tributaries. Rieman and McIntyre (1995) concluded that core areas for migratory bull trout should be represented by drainages or basins ranging in size from about 96 to 965 square miles. The total drainage area for Cabinet Gorge Reservoir is approximately 254 square miles. However, since bull trout are currently only using two tributaries, Bull River and Rock Creek, the usable drainage area for Cabinet Gorge bull trout is far smaller.

In order to support a stable population, a habitat area should not only be large but should meet the biological requirements of the organism. The habitat requirements for bull trout include channel stability, substrate composition, cover, cold temperatures, and migratory corridors (Rieman and McIntyre 1993). Channel stability is important for bull trout because bull trout incubate in the substrate over a long period in the winter and early spring. In addition, young bull trout are closely associated with stream channel substrates, often using substrate for cover (Pratt 1994). Low channel stability and high bedload movement are associated with low numbers of bull trout in some river systems in Idaho (Rieman and McIntyre 1993). In Belt geologies, such as is found in the Cabinet Mountains, stream channels in managed watersheds often exhibit high bed load movement, scour, aggradation, and relatively low diversity of substrates (Kappesser 1992, cited in Rieman and McIntyre 1993).

As described above (see Principle #3), Rock Creek suffers from intermittency, perhaps as a result of riparian logging and fires. In addition, streamflow in Rock Creek is highly variable (from 0 - 300 cfs), stream channel stability is low, and bedload movement is high in the mainstem (Hydrometrics 1987, Smith 1994). The East Fork and West Fork are both more stable with less bedload movement (Smith 1994). Rain-on-snow events are a feature of this drainage which may cause particular problems for bull trout (D. Perkinson, Kootenai National Forest, personal communication, July 25, 1995; Rieman and McIntyre 1993). Overall, channel stability is an important habitat component for bull trout which is lacking in mainstem Rock Creek.

As described above, spawning gravels are uncommon in mainstem Rock Creek. Where spawning gravels do exist, relatively high levels of fine sediments have reduced the quality of spawning habitat.

Cover, either in the form of in-stream wood or high channel complexity, is an important habitat variable for bull trout (Rieman and McIntyre 1993). Mainstem Rock Creek contains relatively low amounts of large woody debris. The East and West Forks both contain considerable amounts of stable, large woody debris (Smith 1994). It is not possible at this time to quantify the amount of cover needed by bull trout (Rieman and McIntyre 1993). However, it is possible that there is inadequate cover available to bull trout in mainstem Rock Creek.

Temperatures in excess of 59ºF are thought to limit bull trout distribution (Fraley and Shepard 1989, Pratt 1985, Ratliff 1992). Water temperature data were not available from Rock Creek for this analysis.

The suitability of Cabinet Gorge Reservoir as summer habitat for bull trout is marginal at best. Cabinet Gorge Reservoir is almost always isothermal and summer temperatures often approach or reach 72ºF (Huston 1985). Temperature in the Noxon slough area of Cabinet Gorge has been measured at 81ºF. The Bull River bay is cooled by discharge from the Bull River and has a temperature profile about 6ºF cooler than the main reservoir (Huston 1985). This cooler water attracts and holds salmonids, possibly including bull trout, during the summer. Overall, bull trout residing in Cabinet Gorge Reservoir are confined to limited areas of cooler water and may be stressed by the relatively warm reservoir water temperatures.

The presence of migratory corridors is the fifth characteristic identified as particularly important for bull trout (Rieman and McIntyre 1993). The lack of migratory corridors in the Rock Creek and Cabinet Gorge ecosystem is discussed above (See Principle #1). In conclusion, the size and suitability of the available habitat for Rock Creek and Cabinet Gorge bull trout appears to be marginal.

A corollary to the principle that bigger habitat area is better is the principle that large populations are better than small populations. Rieman and McIntyre (1993) concluded that the risk of extinction may greatly increase where migratory populations include fewer than 50 to 100 redds, or where resident populations include fewer than 1,000 to 2,000 bull trout that are yearling or older. Redd counts in the Bull River in recent years have been 12 in 1992, 16 in 1993, and 23 in 1994 (only partially completed survey). Although adult bull trout have been observed in mainstem Rock Creek, only a single redd has been found (WWP 1996). This redd was located just below the confluence of Engle Creek. Three other redds were identified in 1993 in the East Fork Rock Creek. High flows prevented the successful completion of redd counts in 1994 and 1995. Because Bull River and Rock Creek are the only two tributaries which feed into Cabinet Gorge Reservoir, the migratory population from Cabinet Gorge is clearly at increased risk of extinction due to limited numbers of redds.

Based on data collected during baseline surveys, an estimate was made of the total number of bull trout in the Rock Creek drainage. This number is based on the number of miles of perennial stream inhabited by bull trout and the average number of bull trout in the study sections during three years of sampling. There are approximately an average of 76 bull trout in mainstem Rock Creek, 87 bull trout in the West Fork Rock Creek, and 1,119 bull trout in the East Fork Rock Creek, for a total of 1,282 fish in the drainage. This number includes fish of all sizes and may be an overestimate of the number that are yearling or older. Estimates of length-at-age found bull trout averaged between 2.6 and 3.7 inches at age 1 (Huston, pers. comm., December 20, 1993; Hightower and Vashro 1987, Barnard and Vashro 1986). Bull trout in the population estimates above ranged in size down to 2.2 inches. More recent population estimates indicated a total of 2,643 bull trout in Rock Creek and its tributaries, 272 of which were in mainstem Rock Creek (WWP 1996).

Principle #5: "High reproductive rates are more secure than low reproductive rates."

Populations with low rates of increase have higher extinction probabilities because of their slow recovery. Habitat changes that reduce population size or productivity decrease persistence probabilities (Ruggiero et al. 1994b).

One of the difficult problems biologists are facing with regard to the conservation of bull trout is the widespread distribution of the non-native brook trout throughout the bull trout range. Hybridization between brook trout and bull trout has been reported in Montana (Leary et al. 1983, Clancy 1993), Alberta (Scott and Grossman 1973), and Oregon (Markle 1992). The hybrids are almost always sterile (Leary et al. 1993). The frequent production of sterile interspecific hybrids is an unstable situation that should lead to the loss of one of the two parental types. Life history differences between bull and brook trout tend to favor the brook trout in this situation (Leary et al. 1993). Brook trout become sexually mature at age two or three, are relatively short-lived, and tend to "overpopulate" small streams. In contrast, bull trout do not reach sexual maturity until 3-6 years, and are long lived (Scott and Crossman 1973).

Brook trout may be able to outcompete bull trout in some habitats, particularly those containing more sediment and higher temperatures. Brook trout tend to have higher survival-to-emergence than cutthroat trout and bull trout in high sediment habitats (Hausle and Coble 1976; Irving and Bjornn 1984, cited in Clancy 1993; Weaver and Fraley 1991). In the Bitterroot Forest, Montana, bull trout are found only in small numbers in 20 percent of the high risk drainages. (High risk drainages are those with a high level of development). Brook trout are found in 85 percent of the high risk drainages. This distribution indicates that brook trout may be more competitive in drainages that are adversely affected by development (Clancy 1993). Brook trout are the dominant fish in Engle Creek and are relatively abundant in section RC-2 of mainstem Rock Creek. They are rare in the rest of the mainstem of Rock Creek and are not found in the East and West Forks. Section RC-2 also supports perennial flows and contains spawning gravels. Large, apparently migratory, bull trout have been found in section RC-2. No genetic analysis has been done on Rock Creek bull trout to determine if hybridization is currently occurring. However, hybridization with brook trout is clearly a risk in this drainage.

As described above, migratory bull trout in Cabinet Gorge Reservoir also utilize the Bull River for spawning. In fact, the Bull River supports a far larger run of bull trout than Rock Creek (Pratt and Huston 1993). The Bull River also has sediment that are high enough (55.4 percent in the Bull River, 42.3 percent in the Middle Fork Bull River, and over 50 percent in the East Fork of the Bull River) to adversely affect bull trout survival (Weaver 1993; Smith, pers. comm., March 31, 1995). In addition, bedload deposits threaten to dewater an important spawning area on the East Fork of the Bull River. Hot fires that occurred in the North Fork of the East Fork in the summer of 1994 and the associated removal of riparian and upland vegetation may result in higher sediment levels in the East Fork in the future (Pratt 1994). Brook trout are also widely distributed throughout the Bull River drainage (Pratt and Huston 1993).

Fecundity rates have not been well defined for bull trout. Rieman and McIntyre used a fecundity (F) by length (L) relationship for bull trout of $F=0.0003*L^{2.57}$. Assuming that bull trout mature in Rock Creek at age 4, the available length-at-age data indicate that an age 4 bull trout in Rock Creek is 7.9-10.6 inches (Huston 1993, Hightower and Vashro 1987). Therefore, an average age 4 female would have between 246 and 527 eggs. Many bull trout populations are believed to have alternate year spawning (50 percent of all females spawn in any year) (Fraley and Shepard 1989, Rieman and McIntyre 1995). Age 4 and older bull

trout are rare in Rock Creek (Hightower and Vashro 1987) and it appears their reproductive potential is limited. These data are not applicable to the Cabinet Gorge migratory bull trout as they may mature later and/or at a larger size.

In summary, low reproductive rates contribute to the insecurity of resident populations of bull trout in Rock Creek and of the migratory Cabinet Gorge population which uses Rock Creek and the Bull River for spawning.

Principle #6: "Environmental conditions that increase variance in growth rates decrease probability of persistence."

If habitat changes increase the variability of reproduction, mortality, or dispersal, the population is less likely to persist, even if the mean reproductive rate remains constant over time (Ruggiero et al. 1994b). There are an insufficient quantity of data in Rock Creek to determine the current variance of population growth rates over time. In Cabinet Gorge Reservoir, records of fish caught by experimental gill net sets are available for the 1955 - 1990 period. Pratt and Huston (1995) reviewed these data and concluded that the bull trout population in Cabinet Gorge Reservoir is small, but relatively stable. They also concluded that this population is likely fragile.

Statement of Findings

Adfluvial (migratory) bull trout in the lower Clark Fork/Rock Creek/Bull River/Cabinet Gorge Reservoir metapopulation are at risk due to fragmented habitat, migration barriers, small available habitat areas, degraded habitat conditions, low predicted survival to emergence, threats of hybridization with brook trout, and low total population size. The proposed project and other concurrent activities may jeopardize the continued existence of adfluvial bull trout in Rock Creek by increasing sediment loads during mine construction or in the event of a severe mine-related accident. The fishery management goal of Montana Fish, Wildlife & Parks in Cabinet Gorge and its tributaries is to enhance bull trout populations (Montana Fish, Wildlife & Parks 1997). For reasons discussed above in Principles #1 - #6, population viability can be best increased, if successful, by passing adfluvial bull trout to and from Lake Pend Oreille and the Cabinet Gorge system, including Rock Creek. Fish passage is a major issue being negotiated in the relicensing of Washington Water Power's Cabinet Gorge and Noxon Rapids dams, and testing of passage measures looks promising. Adfluvial bull trout are an important component of bull trout populations within the Cabinet Gorge system because of their migratory nature (again, see Principles #1 - #6 above). Loss of the adfluvial bull trout component, or their habitat, in Rock Creek would decrease the likelihood of successful restoration or maintenance of bull trout in the Cabinet Gorge system.

Resident bull trout in the metapopulation are vulnerable for reasons similar to those described above for adfluvial bull trout. Almost all the resident bull trout in the Rock Creek system are found upstream of the proposed mill site. Resident bull trout in the mainstem of Rock Creek may be adversely affected by increased sediment loading. The proposed project and other concurrent activities are not likely to jeopardize the continued existence of the resident component of the metapopulation, however, because only minor impacts, if any, are expected to occur upstream of the proposed mill site, where most of the resident bull trout are found.

Potential Measures for Removing, Avoiding, or Compensating for Adverse Effects

I. *Mitigation*

High risk best management practices have been shown to be 85 percent effective in reducing impacts to watersheds on federal lands (Mathieus 1996). Additional sediment source reduction activities totaling 40 acres should be completed to mitigate for sediment produced in spite of BMPs. These sediment source reductions can be in the Rock Creek or Bull River drainages. This acreage would be in addition to 74 acres discussed earlier under sediment.

If fisheries monitoring shows an increase in the abundance of non-native species in the Rock Creek drainage, several actions will be needed. First, impacts to the environment that could be causing the spread of the non-native-fishes should be identified and corrected if possible. If ASARCO is responsible for the declines in fish habitat or is responsible in any other way for the spread of non-native species then it will be ASARCO's responsibility to undertake mitigation. It may be necessary to remove the non-native fish through the use of electrofishing or toxicants.

INFISH recommends the development and implementation of a road management plan to avoid adverse effects to inland native fish. ASARCO would develop this plan, in cooperation with the agencies, to include the items specified in INFISH. This plan is needed to help avoid the adverse effects of transportation-related accidents and road maintenance impacts to bull trout in Rock Creek. Where the road encroaches upon the stream, the streambank should be stabilized with large, clean rip rap, rootwads, and seeded with native vegetation capable of holding soils.

In the event of a mine-related accident that adversely affected aquatic life in Rock Creek or the Clark Fork River, ASARCO would be required to undertake mitigation. The agencies, in consultation with ASARCO, would develop a plan aimed at restoring the waters to their pre-accident condition.

II. *Monitoring*

A monitoring plan describing sampling and reporting procedures is found in Appendix H of the Draft Environmental Impact Statement. No additional monitoring is proposed in this biological assessment.

References not already cited in DEIS

Clancy, C.G. 1993. Statewide fisheries inventory: Bitterroot Forest inventory. Montana Department of Fish, Wildlife, and Parks. Job Completion Report, Project F-46-R-4-Ij.

Forest Service/BLM. 1997. Upper Columbia River Basin Environmental Impact Statement. Interior Columbia Basin Ecosystem Management Project. USDA Forest Service, Intermountain and Northern Regions and USDI Bureau of Land Management, Idaho, Montana, Nevada, Utah, and Wyoming. Two volumes.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology, and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science. 63:133-143.

Hausle, D.A. and D.W. Coble. 1976. Influence of sand in redds on survival and emergence of brook trout (*Salvelinus fontinalis*). Trnas. Am. Fish. Soc. 105:57-63.

Hydrometrics. 1987. Water resources baseline study. ASARCO Rock Creek project. Prepared for ASARCO, Inc., Wallace, ID.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4):856-865.

Markle, D.F. 1992. Evidence of bull trout x brook trout hybrids in Oregon. In: Howell, P.J. and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workship. Oregon Chapter of the American Fisheries Society. Corvallis, OR.

Montana Fish, Wildlife and Parks. 1997. Montana Warm Water Fisheries Management Plan: 1997-2006. Montana Fish, Wildlife and Parks. Helena, MT.

Pratt, K.L. 1985. Pend Oreille trout and char life history study. Idaho Department of Fish and Game, Boise, ID.

Pratt, K.L. 1994. Habitat use and species interactions of juvenile cutthroat trout (*Oncorhynchus clarki lewisi*) and bull trout (*Salvelinus confluentus*) in the Upper Flathead River basin. Thesis prepared in partial satisfaction of M.S., University of Idaho, Moscow, ID. 95 pp.

Ratliff, D.E. 1992. Bull trout investigations in the Metolius River-Lake Billy Chinook system. pp. 37-44 In: Howell, P.J. and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workship. Oregon Chapter of the American Fisheries Society. Corvallis, OR.

Rieman, B.E. and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124:285-296.

Ruggiero, L.F., G.D. Hayward, and J.R. Squires. 1994b. Viability analysis in biological evaluations: concepts of population viability analysis, biological population, and ecological scale. Conservation Biology, 8(2):364-372.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Bulletin 1984. Fisheries Research Board of Canada. Ottawa, Canada.

Watershed Consulting. 1997. 1996 Field data summary report for Rock Creek near Noxon, Montana. Final. Prepared for ASARCO Inc., Troy, MT. Watershed Consulting, Polson, MT.

Weaver, T.M. 1993. Evaluation of fish habitat in the East Fork Bull River drainage, March 1993. Prepared for Washington Water Power Co., Spokane, WA.

WWP. 1996. Lower Clark Fork River tributary survey. Final Report. Washington Water Power Company, Spokane, WA. Two volumes.

APPENDIX C

PRELIMINARY SECTION 404(b)(1) SHOWING

APPENDIX C

PRELIMINARY SECTION 404(b)(1) SHOWING

ASARCO Incorporated - Rock Creek Mine Project

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REVISED

PRELIMINARY SECTION 404(b)(1) SHOWING
DA Permit No.
ASARCO Incorporated - Rock Creek Mine Project

This document represents the opinions of the Kootenai National Forest (KNF) and Montana Department of Environmental Quality (DEQ), hereinafter referred to as the Agencies, as to how Alternative V complies with the requirements of the 404(b)(1) guidelines. This Showing is not intended to represent the Corps of Engineers' conclusions or their Final 404(b)(1) Evaluation. This Showing is provided to solicit public input, comments, and foster increased public awareness and participation in the Environmental Impact Statement (EIS) process.

1.0 SUBPART A - GENERAL INTRODUCTION

The 404(b)(1) Guidelines (40 CFR 230) are the substantive criteria used in evaluating discharges of dredged or fill material in waters of the United States (Waters of the U.S.) under Section 404 of the Clean Water Act, and are applicable to all 404 permit decisions. Fundamental to these Guidelines is the precept that dredged or fill material should not be discharged into an aquatic ecosystem unless it can be demonstrated that such discharges would not have unacceptable, adverse impacts either individually or in combination with known or probable impacts of other activities affecting the ecosystems of concern.

Subpart B of the Guidelines outlines restrictions imposed on all discharges, the factual determinations required by the Guidelines and specifications for a determination of compliance or non-compliance with the Guidelines.

Section 230.10(a) states no discharge of dredged or fill material shall be permitted, except as provided under Section 404(b)(2) of the Clean Water Act, if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

Section 203.10(b) establishes three conditions, applicable to inland waters, which must be satisfied to make a finding that a proposed discharge complies with the Guidelines. No discharge of dredged or fill material shall be permitted if it:

a) Violates applicable state water quality standards;

b) Violates any applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act; or

c) Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat which is determined to be a critical habitat.

Section 230.10(c) provides that no discharge of dredged or fill material shall be permitted if it will cause or contribute to significant degradation of the Waters of the U.S., except as provided under Section 404(b)(2).

Section 230.10(d) prohibits the discharge of dredged or fill material, except as provided under Section 404(b)(2) of the Clean Water Act, unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem.

Section 230.11 requires the permitting authority to determine in writing the potential short-term or long-term effect of a proposed discharge of dredged or fill material on the physical, chemical, and biological components of the aquatic environment in light of subparts C-F. The determinations of effects of each proposed discharge shall include the following:

a) Physical substrate determinations;

b) Water circulation, fluctuation, and salinity determinations;

c) Suspended particulate and turbidity determinations;

d) Contaminant determinations;

e) Aquatic ecosystem and organism determinations;

f) Proposed disposal site determinations;

g) Determination of cumulative effects on the aquatic ecosystem; and

h) Determination of secondary effects on the aquatic ecosystem.

Subparts C through F lists the effects of the potential impacts on the physical and chemical characteristics of the aquatic ecosystem; the potential impacts on the biological characteristics of the aquatic ecosystem; the potential impacts on special aquatic sites; and the potential effects on human use characteristics to be considered in making the factual determinations and the findings of compliance or non-compliance in Subpart B. Subpart G sets forth evaluation and testing procedures to provide information necessary to reach the determinations in Subpart B. Subpart H lists actions to be undertaken to minimize the adverse effects of discharges of dredged or fill material.

This section 404(b)(1) showing includes a description of the proposed discharge of fill material to be evaluated under Section 404 of the Clean Water Act and an analysis of the discharge pursuant to Subparts B through H. For the purposes of this showing, primary effects are equated with direct impacts and secondary effects are equated with indirect impacts. Construction-related impacts are considered direct. Indirect impacts can occur at some distance from the project site or can be associated with actions that occur after the project is operational.

Additionally, the Corps of Engineers Regulations 33 CFR 320.4a(2)I-iii require consideration as to the relative extent of the public and private need; where there are unresolved conflicts as to resource use; and the extent and permanence of the beneficial and/or detrimental effect which the proposed structure or work is likely to have on the public and private uses to which the area is suited.

1.1 ASARCO Rock Creek Mine Project - Alternative V Description

The ASARCO Mining Company (ASARCO) has requested permission to place fill material in various Waters of the U.S. in conjunction with the ASARCO Rock Creek mine project. This mining project is an underground hard rock copper and silver mine with the associated above ground processing and waste storage facilities located under and adjacent to the Cabinet Mountain Wilderness Area in the vicinity of Noxon, Montana. ASARCO's Rock Creek Mine Project will have a design capacity of 10,000 tons per day and an anticipated 30-year life-of-mine. The project permit boundary encompasses 2,412 acres, of which approximately 514 acres will be disturbance, and 1,898 acres will remain undisturbed.

The main modifications distinguishing Alternative V from the other alternatives are described in detail in Chapter 2 of this supplemental EIS. The main modifications are the deposition of tailings as a paste and an alternate water treatment system. The use of paste landfill technology for tailings disposal eliminates the need for borrow materials outside of the paste facility site. The use of paste technology is a less damaging method of tailings disposal to wetlands because the direct and indirect impacts to the wetlands under the facility footprint would be phased-in throughout the 34-year project. In addition, the elimination of the borrow site #3 reduces impacts to the riparian area adjacent to Rock Creek where the borrow would have been excavated. ASARCO has submitted design modifications in a report to the Corps titled "Preliminary Designs for Wetlands Mitigation, Alternative 5 - Paste Placement of Tailings" (ASARCO March 26, 1997) (see Appendix N). Changes in the Agencies' 404(b)(1) preliminary showing as a result of these modifications are contained in this Appendix.

ASARCO prepared the first wetlands and Waters of the U.S. inventory for the Rock Creek Mine in 1993 (ASARCO Incorporated 1993). An additional Waters of the U.S. and Wetland Delineation for Copper Lake, Cliff Lake, and Potential Subsidence Areas, Cabinet Mountains Wilderness report was completed and submitted to the agencies and Corps of Engineers in January 1997 (ASARCO Incorporated 1997). Mapping units and their approximate acreage for the inclusive inventoried project areas include: (1) wetlands - 11 acres; (2) non-wetland Waters of the U.S. - 56 acres; (3) wetland complex - 2 acres; and (4) riparian areas - 84 acres. Within the wetland complex and riparian areas are areas which may meet the technical criteria for wetlands but were not mapped because no mining-related impacts were proposed.

The wetlands and Waters of the U.S. inventory included only the areas designated to be either directly or indirectly affected by the proposed mine operations, including the potential subsidence areas in the Cabinet Mountains Wilderness Area. The Corps of Engineers conducted site inspections on September 19-21, 1994 and September 16, 1996 and determined that the inventories were accurate depictions of the jurisdictional wetlands and Waters of the U.S.

Wetlands and Waters of the U.S. within the proposed mine project area were recognized as providing several important functions and values in their ecological role (ASARCO Incorporated 1993; 1997). Wetland functions and values were assessed using best professional judgement based upon the best available literature information (Marble 1992). A formal, standard, semi-quantitative evaluation assessment methodology, such as the habitat evaluation procedure (HEP) or Wetland Evaluation Technique (WET), was not used.

The functions and values of the wetlands within the project area that were considered to be of low importance were ground water recharge, flood-flow alteration, and recreation and uniqueness heritage. Wetlands functions considered to be of low to moderate importance were sediment and toxicant retention, nutrient removal and transformation, shoreline and streambank stabilization, and production export. Groundwater discharge, aquatic diversity and abundance, and wildlife diversity and abundance were considered to be of moderate to high importance. The local importance of seeps and springs and the type and quality of habitat provided by the wetlands and adjacent streams and tributaries provide the higher functions.

Although wetlands in the mine permit area do not sustain fish populations, the Waters of the U.S., including Rock Creek, East Fork Rock Creek, and West Fork Rock Creek, do support fish. Bull trout occur in all three streams and appears to be a permanent resident (ASARCO Incorporated 1993). Wetlands in the mine permit area and the Cabinet Mountains Wilderness Area provide habitat for wildlife, including amphibians, reptiles, mammals, and birds. Wetlands and adjacent Waters of the U.S. provide habitat,

seasonal forage, and breeding and resting areas. No bird or mammal species, that is thought to be dependent or wetlands, was recorded in the wetlands study area (ASARCO Incorporated 1993, 1997). Grizzly bear, which is listed as a threatened and endangered species, may also use the wetlands on a seasonal basis. With respect to wildlife, the impacted wetlands would constitute microsite habitats within a broader habitat component and thus, would not be critical to the wildlife's occurrence, distribution, or survival within the project area.

Approximately 5.6 of the total 6.2 impacted wetland acres are associated with the tailings impoundment (Table C-2). These wetlands are primarily located in broad shallow grassy swales in the ephemeral portions of the South Fork Miller Gulch drainage. The remaining 0.6 acres of impacted wetlands and the 0.4 acres of Waters of the U.S. will be lost due to the construction of the mill site and waste rock dump, and the powerline, pipelines, and access road crossings of the Rock Creek channel.

The wetlands proposed to be filled under Alternative V 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 Upper Perennial Riverine, the Forested Palustrine, and Emergent Palustrine Wetland Systems. Wetlands located along the Rock Creek main channel and its tributaries have developed primarily on the low streamside terraces and would be classified as Upper Perennial Riverine and Forested Palustrine Wetland Systems. Localized wet areas downstream of isolated springs and seeps also occur and would be classified as Forested Palustrine Wetlands. These wetlands have developed primarily in poorly and very poorly drained glaciolacustrine sediments.

Wetlands along the Miller Gulch intermittent drainages 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 would be classified as Emergent Palustrine Wetlands.

Proposed mining and reclamation plans for the Rock Creek Project are detailed in Volume 2, Sections II and III, of the Hard Rock Operating Permit Application submitted to the Montana DEQ and the Kootenai National Forest (KNF). A revised wetlands and Waters of the U.S. mitigation plan, describing the construction of new wetlands is included in Section 3.0 of ASARCO's Preliminary Designs for Wetlands Mitigation Alternative V (ASARCO Incorporated 1997) (Appendix N), and in Chapter 2 of this supplemental EIS. The primary functions and values of the created wetlands would be to reestablish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek and Miller Gulch, and attenuate peak flows.

1.2 Description of filling activities associated with Alternative V, ASARCO Rock Creek Mine Project

Construction and operation of the mine facilities will result in a direct impact through discharge of fill material to about 5.2 acres of wetlands and 0.4 acres of Waters of the U.S. (see Table C-2). Approximately an additional 1.0 acre of wetland will be indirectly affected by the project throughout the project life. Therefore, the affected acreage would total approximately 6.2 acres of wetlands and 0.4 acres of Waters of the U.S. Construction and operation of the tailings paste facility will account for about 4.6 of the 6.2 acres of affected wetlands. The wet paste tailings disposal area will be constructed in nearly the same

location (footprint) as the proposed tailings impoundment (Alternatives II, III, and IV). The remaining 0.6 acres of wetland and 0.4 acres of Waters of the U.S. will be impacted along the Rock Creek channel by the construction of the mill site, waste rock dump, powerline, pipelines, and access road. Fifteen, large-formatted, detailed figures, were originally included in the Wetlands Inventory, Consideration of Alternatives, and Mitigation Plan (Wetlands Report) prepared by ASARCO in 1993 (ASARCO Incorporated 1993). A revised Wetlands Inventory was prepared by ASARCO in 1995 particularly for Alternative IV (ASARCO Incorporated 1995) and the mapped delineations were consolidated onto two large-formatted sheets. All of the figures show the location and extent of the ASARCO Rock Creek project development and operational activities and their relationship to the delineated wetlands and Waters of the U.S.

The wetland acreage to be filled with wet paste tailings and other fill material is presented in Table C-3 for various scheduled phases of the "Life of Project." In general, it is not possible to identify the specific quantities of fill materials placed in the wetlands and Waters of the U.S. for the sites containing large quantities of fill. As much as 1.1 million yds^3 (1.3 million tons) of tailings may be directly placed on top of the approximate 4.6 acres of wetland located beneath the paste tailings footprint. Some smaller quantities of fill materials (estimated 800 yds^3) of on-site borrow materials will be placed in wetlands and crossings of Waters of the U.S. channels during upgrading a portion of FDR No. 150 and constructing the utilities corridors. Some small wetland and Waters of the U.S. may be temporarily impacted by construction equipment working near the areas, but will not be directly filled.

Conventional earth-moving equipment, such as front-end loaders, dump trucks, bulldozers, and rubber-tired scrapers, will be used to place fill material in the wetlands and Waters of the U.S. for all sites except under the paste tailings disposal area. Wetland areas under the paste tailings disposal area will be filled with wet paste tailings discharged from a pipeline.

2.0 SUBPART B - COMPLIANCE WITH THE GUIDELINES

2.1 Section 230.10 - Restrictions on the discharge

2.1.1 Section 230.10(a): Practicable alternative analysis

Five mining alternatives (4 described and analyzed in the draft EIS; one additional included in this supplemental EIS) were developed in response to the significant environmental issues identified during the scoping process and Agencies' discussions. The effects on wetlands and Waters of the U.S. was identified as one of the potential significant issues to drive the development of the alternatives and evaluation of impacts. The affected acreage of wetlands and Waters of the U.S. for each of the four action mining alternatives (alternatives II, III, IV, and V) is shown in Table C-2.

Under Alternative I, the no-action alternative, the project would be denied which provides the baseline for estimating the effects of the other alternatives. All action alternatives would fill wetlands and Waters of the U.S. The tailings impoundment and wet paste disposal area would impact the same acres of wetlands for all action alternatives. The location of the mill site, waste rock dumps (alternatives II and III only), powerline, pipelines, and access road upgrade will determine the total amount of wetlands and Waters of the U.S. impacted by the other action alternatives.

In addition to the five alternatives, a number of alternatives suggested during scoping were determined by the Agencies to be infeasible or otherwise unreasonable. The dismissed alternatives and their

reasons for dismissal are discussed in detail in Chapter 2, Part III of the draft and supplemental EISs. The dismissed alternatives fall under the following topics:

- mill and mine portal siting alternatives;
- tailings impoundment siting and construction methods;
- tailings paste deposition siting alternatives;
- McKay Creek impoundment alternative;
- McKay Creek water retention dam;
- other tailings disposal methods, including backfilling;
- dry tailings backfill transportation method;
- lined tailings disposal facility;
- rail siding (loadout) locations;
- joint venture mineral development; and
- alternate water treatment methods.

The tailings disposal location and method of placement was a critical factor for evaluating each alternative's impacts to wetlands because of the large quantity of tailings and the surface area required for the disposal area. Even though alternatives IV and V have essentially the same acreage of impacts to wetlands and Waters of the U.S., Alternative V is a less damaging alternative for several reasons. Alternative V would result in up to a 25-year delay in the impacts to some wetlands. Successful re-contouring and reclamation of each successive paste panel would help minimize cumulative impacts. Another major advantage of Alternative V is the elimination of the need for large quantities of borrow materials which were to be excavated from a riparian area along Rock Creek.

A total of 21 potential tailings disposal sites were identified and evaluated by the MAC Report (USFS 1986). Four potential tailings disposal sites were further evaluated; a summary of these tailings disposal siting alternatives is presented in Table 2-10 of the draft EIS and in Table C-4 of this 404(b)(1) Showing. Agency evaluations combined the tailings disposal locations and geotechnical components for the further evaluation. Considering the environmental and geotechnical factors, the Rock Creek tailings disposal location was determined to be the practicable and least environmentally damaging tailings impoundment site. Alternative V was considered to be the least damaging practicable alternative. The Agencies considered and dismissed other tailings disposal methods (wet tailings, dry tailings, and backfilling of tailings into the mine). The dry tailings and backfilling alternatives were dismissed because they were either economically or environmentally impracticable. Specific reasons for their dismissal is presented in Chapter 2, Part III of the draft EIS.

2.1.2 Section 230.10(b) - Discharge compliance with guidelines

The 404(b)(1) guidelines Section 230.10(b) require that no discharge shall be authorized if it:

1. Causes or contributes to any violation of applicable water quality standards.

2. Violates any applicable toxic effluent standard or prohibition under Section 307 of the Act.
3. Jeopardizes the continued existence of species listed as threatened or endangered under the Endangered Species Act (ESA) of 1973, as amended, or results in likelihood of the destruction or adverse modification of critical habitat under the ESA of 1973.

The discharge of tailings material at the impoundment site and the discharge of other fill materials proposed for construction and operation of the mine facilities have been evaluated under the following:

State water quality standards: The Montana Department of Environmental Quality (DEQ), Water Quality Division provides Section 401 certification pursuant to the state rules (ARM 16.20.1701 et seq.). The Montana DEQ will review this discharge of material and will make a determination for violations of applicable state water quality standards. Montana DEQ will not make its final ruling until the Corps of Engineers completes their final 404(b)(1) evaluation. Section 404 permits, issued by the Corps of Engineers, require Section 401 certification. Any conditions to the 401 certification will be conditions of the Section 404 permit. A Section 401 certification does not constitute a relinquishment of Montana DEQ Water Quality Division's authority, or any subsequent alterations or additions thereto, nor does if fulfill or waive any other local, state or federal regulations.

Toxic effluent standard or prohibition: Documentation of analysis of material to be discharged as a result of the project is contained in the draft EIS. Determination of compliance with Section 307 of the Clean Water Act is encompassed in the Montana DEQ review. Section 307 requires review of the project in light of the possible introduction of toxic pollutants. As indicated above, water quality certification pursuant to Section 401 of the Clean Water Act will be required. All conditions identified in the Section 401 certification will be included as conditions should the 404(b)(1) evaluation result in a recommendation to issue a permit.

Threatened or endangered species: Impacts to threatened or endangered species were addressed in the draft EIS and are addressed elsewhere in this evaluation. To comply with the Endangered Species Act, the Forest Service will prepare a biological assessment to evaluate the potential effects on threatened and endangered species that may be present in the project area. The U.S. Fish and Wildlife Service (USFWS) will review the biological assessment and render a biological opinion. If the USFWS determines that the preferred alternative may jeopardize the continued existence of a species, it may offer a reasonable and prudent alternative that would, if implemented, preclude jeopardy. ASARCO must successfully meet the requirements of this section of the 404(b)(1) guidelines in order for the 404(b)(1) evaluation to result in a recommendation to issue a permit. The applicant realizes failure to meet the requirements of this section will result in a recommendation of denial.

2.1.3 Section 230.10(c) - Degradation of Waters of the U.S.

Project impacts which would cause or contribute to significant degradation of Waters of the U.S. are addressed throughout the supplemental EIS and the draft EIS. The recommendation to issue a permit will be based on the assessment of the project impacts and the proposed mitigation. In order to conclude that the Rock Creek Mine project will not cause or contribute to a significant degradation of Waters of the U.S., ASARCO must successfully met the requirements of this section of the 404(b)(1) guidelines.

Section 230.10(c) of the guidelines prohibits the discharge of dredge or fill material which will cause or contribute to significant degradation of Water of the U.S. Findings of significant degradation must be based on factual determinations, evaluations, and testing. 33 CFR Part 320.4(b)1-3 also states that the unnecessary alteration or destruction of wetlands should be discouraged as contrary to the public interest.

From a national perspective, the degradation or destruction of wetlands, and other special aquatic sites, is considered to be the most severe environmental impact covered by the 404(b)(1) guidelines. Wetlands perform various functions that are vital to the integrity of the wetland system and contribute to the overall quality of the nation's waters. Examples of these wetland functions are groundwater recharge and discharge, sediment stabilization, sediment/toxicant retention, and nutrient removal/transformation. Other wetland functions considered to be important to the public interest and which serve significant biological functions are the providing of: general habitat (nesting, spawning, rearing, and resting sites); aquatic diversity and abundance; wildlife diversity and abundance; recreation; and uniqueness in nature or scarcity in the region.

ASARCO completed the identification and delineation of wetlands and Waters of the U.S. for the Rock Creek project area with technical assistance from Western Technology and Engineering Inc. and Hydrometrics, Inc. (Wetlands Inventory, ASARCO 1993; 1997). Only wetlands and Waters of the U.S. in

areas designated to be either directly or indirectly affected by the proposed mine operations, including potential subsidence areas in the Cabinet Mountains Wilderness Area were inventoried. The Corps of Engineers conducted site inspections on September 19-21, 1994 and September 16, 1996 and determined that the inventories were accurate depictions of the jurisdictional wetlands and Waters of the U.S. Most of the delineation work was conducted using the intermediate-level onsite determination method.

Approximately 5.6 of the total 6.2 impacted wetland acres are associated with the wet paste tailings disposal area. These wetlands are primarily located in broad shallow grassy swales in the ephemeral portions of the South Fork Miller Gulch drainage. The wetland areas directly under the wet paste tailings disposal area do not provide aquatic/fisheries habitat since they are generally isolated from the main stream channels. The remaining 0.6 acres of wetlands will be lost along the Rock Creek and Miller Gulch drainages due to the construction of the mill site, topsoil stockpile, diversion ditches, powerline, pipelines, and access road upgrade. These wetland sites may provide important aquatic habitat for fisheries; habitat for plant species of special concern (pointed broom sedge, black snake-root, and fringecup); and sensitive wildlife species habitat (such as the harlequin duck). Detailed information on aquatics/fisheries, plant species of special concern, and wildlife is included in chapters 3 and 4 of the draft and supplemental EISs.

The cumulative impacts from all action alternatives for the Rock Creek Mine project, combined with impacts from the Montanore project and projected timber sales in the Rock Creek drainage, may decrease the amount of wetlands and Waters of the U.S. and their ecological functions. Aquatic and wildlife diversity and abundance are considered to be the two most important wetland and Waters of the U.S. functions. Development of the proposed tailings paste deposal area would impact more than 300 acres of the natural watershed in the Miller Gulch drainage. Temporary surface water collection channels and water management practices during paste deposition will alter the natural hydrology, particularly in tributary M-3. Long-term decreased soil water infiltration rates for the paste tailings compared to native soils may potentially alter the frequency and duration of saturation, inundation, and ponding of water for some downgradient wetlands within the North Fork of Miller Gulch drainage.

2.1.4 Section 230.10(d) - Appropriate and practicable steps to minimize potential adverse impacts of the discharges on the aquatic ecosystem

The primary steps to minimize potential adverse impacts to wetlands and Waters of the U.S. pertain to locating the mine facilities to maximize wetland avoidance. The major mine facilities which were located or modified to maximize wetland avoidance include:

(1) Main access road
(2) Utility corridors (powerline, pipelines)
(3) Mill site facilities
(4) Successive wet paste tailings panel construction, topsoil stockpiles, and diversion ditches

In addition, several alternative facility locations were identified for the waste rock dump sites, mill facility, tailings impoundment sites, and access road upgrades. Other project-related alternatives were identified and considered to avoid or reduce impacts to wetlands and Waters of the U.S. They include (1) backfilling the underground mine with tailings, (2) backfilling the underground mine with waste rock, (3) underground milling, and (4) off-site milling.

Project impacts which would affect wetlands or Waters of the U.S. are addressed in the following text, in accordance with the 404(b)(1) guidelines. Appropriate and practicable steps have been developed to minimize potential adverse impacts on the wetlands and Waters of the U.S. In the event a 404 permit is approved and issued, these steps, including permit conditions and best management practices, will be incorporated into the 404 permit to ensure the project complies with this section of the guidelines. In addition, ASARCO has proposed wetland mitigation, to offset adverse impacts, which is describe in the following section.

Wetland Mitigation Plan

In compliance with Section 404(b)(1) of the Clean Water Act, ASARCO has proposed a mitigation plan providing mitigation and compensation for the loss and potential diminishment of wetland functions and values associated with development of the proposed project (ASARCO Incorporated 1997). ASARCO's mitigation plan is presented in Appendix N. In the most recent wetlands mitigation plan for Alternative V, ASARCO proposes to create 7.0 acres of wetlands to compensate for a total loss of 6.7 acres of Waters of the U.S. and wetlands. The primary functions and values of the created wetlands would be to re-establish diversity and abundance of habitat for aquatic and terrestrial species, reduce sediment transport to Rock Creek and Miller Gulch, and attenuate peak flows. In addition, ASARCO has identified three optional wetland mitigation sites that could be developed if the proposed sites prove to be less successful than anticipated for replacing the lost wetland functions and values.

ASARCO has identified three main wetland mitigation sites along with three additional wetland sites (see **Figure 2-19**). One additional site that could be developed is routing storm water around the tailings paste disposal site into an ephemeral drainage of the South Fork of Miller Gulch. The proposed acreage and mitigation schedules for the created wetlands are provided in **Table 2-7**. Detailed descriptions, including site development, design specifications, and schedules, are presented in ASARCO's wetlands mitigation plan (ASARCO Incorporated 1997). The proposed wetlands mitigation consists of creating: 1) 1.2 acres of wetlands at the Miller Gulch Tributary site; 2) 4.4 acres of wetlands at the Upper Rock Creek site; and 3) 1.4 acres of wetlands at the Lower Rock Creek site. All proposed wetland mitigation sites are within the proposed permit boundary.

The Miller Gulch Tributary wetland site will consist of a series of earthen flow barriers across a small side tributary to Miller Gulch. The flow barriers will be designed to retain surface water runoff and create seasonally saturated soils and wetland hydrologic conditions. The eight small earthen dikes will be constructed at approximately 200-foot intervals along a 1,500 foot segment of the tributary. Each dike will have a rock-lined spillway. The upstream soils and subsoils may be sealed or lined if the hydraulic conductivities are determined to be greater than about 1×10^{-6} to 10^{-7} centimeters per second. Hydric soils from wetland areas to be filled by the surface disposal of tailings paste will be salvaged and directly respread on the mitigation sites to provide organic matter and a plant material source. The site will be broadcast seeded with a forested wetland seed mix (Table 3-3 in ASARCO Incorporated 1997). Containerized western red cedar or black cottonwood trees will also be planted in selected areas at densities provided in Table 3-3 (ASARCO Incorporated 1997).

The Upper Rock Creek wetland site will consist of linear channels constructed in a non-wetland site. The channels will be excavated to depths which will allow saturation and inundation by shallow groundwater. Demonstration pits were excavated with a backhoe at two locations in November 1996, and saturated gravels overlying clay were encountered at about eight feet below ground surface at both sites. Variable channel

widths, small depressions, and benches on one or both sides of the channel bottoms will help create variable depths of saturation and inundation and a more natural looking configuration. Soils will be salvaged from the disturbed areas, respread on the regraded channel bottoms and sideslopes, and disced or harrowed to provide a proper seedbed. The Upper Rock Creek wetland site will be broadcast seeded with a herbaceous wetland seed mix (Table 3-4 in ASARCO Incorporated 1997). The sites will be mulched with noxious weed-free straw or cellulose fiber mulch.

The Lower Rock Creek wetland site will also consist of constructed linear channels, but will not be excavated to ground water. Instead, the Lower Rock Creek wetland sites will rely on concentrating seasonal runoff water and temporary retention of water to create wetland hydrology. Small flow barriers (detention dikes) may be added in the channel bottoms to create longer periods of inundation. Topsoil from the site will be salvaged and respread over all disturbed areas. The site will be broadcast seeded with a herbaceous wetland seed mix (Table 3-4 in ASARCO, Inc. 1997). The proximity of the site to Rock Creek wetland areas may allow for some natural invasion and establishment of hydrophytic species.

2.2 Section 230.11 - Factual determinations

The potential adverse impacts of discharging fill and wet paste tailings material on the physical, chemical, and biological components of the wetland and aquatic ecosystem have been evaluated. Mitigation efforts to offset adverse impacts have been considered in this 404(b)(1) showing and in the supplemental EIS. Determination of these impacts have included the following:

2.2.1 Section 230.11(a) Physical substrate determinations

The discharge and disposal of tailings paste from the Rock Creek Mine project will ultimately create a constructed tailings paste facility that covers approximately 305 acres with another 20 acres impacted by associated features (estimated total 325 acres). Approximately 4.6 acres of wetlands will be directly filled with the tailings paste and an additional 1.0 acre of wetlands downstream of the impoundment will be indirectly affected by the capture and diversion of surface water during construction and reduced surface soil infiltration under the facility. An additional 0.6 acres of wetland will be filled along Rock Creek due to construction of the mill site, powerline, pipelines, and access road upgrades.

Soils under the tailings impoundment area have developed in lacustrine materials (materials deposited in quiet waters) which occur on the higher terraces close to the confluence of Rock Creek and the Clark Fork River. These soils have ash-influenced surface horizons with high organic matter content. The soils along Rock Creek have developed predominantly in alluvial materials (deposited by moving water) and also have high organic matter contents in the upper ash-influenced surface horizons. Site specific soil information is presented in the draft EIS.

The mineralogical and physical composition of the tailings paste materials will be variable, but different than the lacustrine substrate. Characteristics of the waste rock material at ASARCO's Troy and Rock Creek projects are provided in Table 4-17 of the draft EIS. Initial testing of the potential tailings material indicate a net neutralizing potential (see Table 4-13 in the draft EIS). The tailings materials have a low sulfide content. The results of analyses performed to date suggest that exposure of Rock Creek ore and waste rock by mining would not generate acid mine water. Additional Acid Base Accounting (ABA) would be performed during the construction of the exploration adit to ensure the adit and excavated material were not acid generating.

The types of fill material placed in the 0.6 acres of wetland along Rock Creek will include mine waste rock, local gravel, on-site borrow, topsoil, and subsoil. These fill materials may have similar mineralogical and physical characteristics as the substrate materials.

2.2.2 Section 230.11(b) Water circulation, fluctuation and salinity determinations

As described in this showing (See 4.4 Section 230.23) natural water circulation and fluctuations in the small ephemeral portions of the North and South Forks of Miller Gulch drainage would be impacted by the capture and diversion of surface water around the tailings paste facility during construction and by the reduction of surface water infiltration in the 325 acre site. The discharge of fill materials along Rock Creek will be predominantly above the creek channel and will have limited impacts on circulation and fluctuations of Rock Creek water. Salinity levels are not expected to change.

2.2.3 Section 230.11(c) Suspended particulate/turbidity determinations

Discharges of fill materials and associated construction activities in the Rock Creek and Miller Gulch drainages would temporarily increase sediment contributions to wetlands and Waters of the U.S. Soil erosion and transport would occur primarily during filling (construction) activities and prior to vegetation establishment. Aquatic organisms would be impacted and a temporary decline in biological productivity can be expected. Inclusion of Montana DEQ Section 401 permit conditions, as well as other conditions to control sedimentation and turbidity, will minimize these impacts. In addition, ASARCO's proposed best management practices will be implemented to control erosion and reduce sedimentation. Erosion control measures are described in detail throughout ASARCO's permit application. These measures involve mechanical practices, soil-handling techniques to enhance stability, hydrologic measures to control runoff and sedimentation, and revegetation practices to provide a stabilizing cover.

2.2.4 Section 230.11(d) Contaminant determinations

See Section 7.0 - EVALUATION AND TESTING (230.60 and 230.61).

2.2.5 Section 230.11(e) Aquatic ecosystem and organism determinations

The mining project would result in impacts to aquatic organisms due to the direct discharge of fill materials to 5.2 acres of wetland and 0.4 acres of Waters of the U.S., and the indirect impacts to another 1.0 acre of wetland. In addition, other activities, such as constructing the water treatment facility, logging the proposed disturbed areas, salvaging topsoil and subsoil, and construction the wetland mitigation sites would likely create sedimentation which would result in impacts. The physical, chemical, and biological integrity of Rock Creek would be modified particularly at the locations where the mine access road and mine utilities (powerline, pipelines) cross the Rock Creek channel. Adverse impacts would also occur to the 4.6 acres of wetland to be directly filled with tailings paste. If the Corps of Engineers permit evaluation concludes that a 404 permit should be issued, special conditions may be attached to the permit requiring monitoring and restoration if ASARCO's proposed best management practices are less than successful at erosion control.

Terrestrial wildlife species inhabiting areas near impacted stream segments and dependent on the aquatic ecosystem would be affected by the mining project. Species currently inhabiting the areas to be destroyed by tailings paste filling activities, will compete for existence in surrounding areas containing similar habitat.

2.2.6 Section 230.11(f) Proposed disposal site determinations

As previously stated, the Montana DEQ Water Quality Division provides Section 401 certification pursuant to Section 401 of the Clean Water Act. The Montana DEQ has reviewed this discharge of material and will make a determination for violations of applicable state water quality standards. However, Montana DEQ will not make its final ruling until ASARCO submits a final Water Management Plan for the Rock Creek Mine project. No section 404 permits will be issued by the Corps of Engineers without the Section 401 water quality certification.

The proposed tailings paste disposal area would completely fill approximately 4.6 acres of wetlands. Criteria normally applied to mixing zone determinations is not applicable to these sites. The mixing zones at the locations where the mine access road and mine utilities (powerline, pipelines) cross the Rock Creek channel will be limited to the immediate areas of the discharge points. In addition, implementation of the best management practices will help reduce erosion and sedimentation, and limit the mixing zones to the immediate areas where the crossings occur on Rock Creek.

2.2.7 Section 230.11(g) Determination of cumulative impacts on the aquatic ecosystem

An analysis of cumulative impacts is contained for each resource area in Chapter 4 of the draft EIS (July 1995) and this supplemental EIS. Cumulative impacts are the collective impacts for the project when considered in conjunction with other past, present, and reasonably foreseeable activities. Cumulative impacts for the Rock Creek project include 730 acres of planned timber sales, potential land exchange, possible road closures, probable increase in recreation, and the Montanore project impacts.

The cumulative impacts from all action alternatives for the Rock Creek Mine project, combined with impacts from the Montanore project and projected timber sales in the Rock Creek drainage, may decrease the amount of wetlands and Waters of the U.S. and their ecological functions. Aquatic and wildlife diversity and abundance are considered to be the two most important wetlands and Waters of the U.S.functions. Development of the proposed tailings paste disposal area would remove more than 300 acres of natural watershed in the Miller Gulch drainage. Temporary surface water collection channels and water management practices during paste deposition will alter the natural hydrology in the Miller Gulch drainage. Long-term decreased soil water infiltration rates and soil hydraulic conductivities in the paste tailings materials compared to native soils and lacustrine sediments may alter the frequency and duration of saturation, inundation, and ponding of water for some downgradient wetlands within the Miller Gulch drainage.

2.2.8 Section 230.11(h) Determination of secondary effects on the aquatic ecosystem

A catastrophic failure of a tailings paste panel, considered a very low-probability event, would create an uncontrollable release to the environment. Should failure occur, tailings paste and waters would likely fill adjacent wetlands and Waters of the U.S. and create adverse impacts to the aquatic ecosystem. Portions of the tailings paste mass would probably remain in stream channels for an undefined period of time.

Other secondary effects on the aquatic ecosystem from the Rock Creek project support activities may result from an increased surface runoff (and sedimentation) from cleared areas and the face of the tailings paste facility. Also, the temporary surface water collection channels and water management practices during paste deposition may create secondary effects on the natural hydrology and aquatics ecosystems in the North and South Forks of Miller Gulch drainage.

2.3 Section 230.12 Findings of compliance or non-compliance with the restrictions on discharge

Based on the Agencies' preliminary assessment, data contained in the draft EIS and supplemental EIS, the determinations of the preceding section, and the remainder of this showing, it appears that the discharge of the tailings paste and the road and utility crossings would comply with the requirements of these guidelines with the inclusion of appropriate and practicable implementation of Best Management Practices and the permit conditions to minimize any adverse effects of the discharge to the aquatic ecosystem. Alternative V would be the least damaging practicable action alternative because the tailings paste disposal method would result in up to a 25-year delay in the impacts to some wetlands. Also, this disposal method would eliminate the need for large quantities of borrow that would be excavated from a riparian area along Rock Creek.

3.0 SUBPART C - POTENTIAL IMPACTS ON THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Potential impacts of the discharge of fill from the Rock Creek project on the physical, chemical, and biological components of the aquatic environment have been evaluated. Mitigation efforts to offset adverse impacts and the mitigation ratios have not been finalized. Additional mitigation may be considered in the final evaluation upon review and approval of detailed engineering designs and drawings. Determination of these impacts include the following:

3.1 Section 230.20 Physical substrate determinations

As previously stated, the disposal of tailings paste will ultimately create a tailings facility that covers approximately 305 acres in the Miller Gulch drainage. Approximately 4.6 acres of wetland will be directly filled with tailings. An additional 0.6 acres of wetland will be destroyed along Rock Creek from the construction of the mill site, powerline, pipelines, and access road upgrade. Surface soil materials from under the tailings paste disposal area will be salvaged and stockpiled prior to paste deposition activities. Stockpiled soils will be used for reclaiming the tailings paste surface and outer edges when final contours and grades are achieved. Hydric soils (wetland soils) will be salvaged from the 4.6 acres of delineated wetlands to be affected by the tailings paste facility. The hydric soils will be directly respread on the Miller Gulch wetland mitigation sites to provide increased organic matter and a plant materials source. Soil salvage is not proposed for the other wetland areas (0.6 acres) due to their small size, inaccessibility to heavy equipment, and the additional adverse impacts which could result from the use of heavy construction equipment necessary to salvage the small amount of material available from these sites. Site specific soil information is presented in the draft EIS.

3.2 Section 230.21 Suspended particulates/turbidity

An increase in the suspended particulates and turbidity in the Waters of the U.S. (Rock Creek channel) and water flowing through the delineated wetlands will occur during fill (construction) activities. Of primary concern for the lower portion of Rock Creek, is the potential impact of increased sedimentation on Bull trout spawning. The Bull trout spawns in depositional areas and increased sedimentation could have a significant impact on their reproduction rates. Erosion control measures are described in detail throughout the Rock Creek Mine permit application. These measures involve mechanical practices, soil-handling techniques to enhance stability, hydrologic measures to control runoff and sedimentation, and revegetation practices to provide a stabilizing cover. With the inclusion of these best management practices and the Forest

Service and state soil and water conservation practices as well as reduction of existing sediment sources outside the permit area within the Rock Creek drainage, any project-related increase in the suspended particulates and turbidity in Rock Creek should not have a significant impact on the fishery.

3.3 Section 230.22 Water clarity, nutrients, environmental characteristics and values (chemistry)

The discharge of tailings paste and construction of surface water runoff collection channels will create short-term impacts to water characteristics. During paste deposition activities, surface water will be channeled and diverted around the paste area and may have increased suspended solids and nutrients. The surface water runoff from the active paste panels will be routed to the storm water retention ponds and used in the process water loop. An increase in total nitrogen (nitrates, nitrites, and ammonia) from water discharge from the water treatment plant could lead to eutrophic or hypereutrophic conditions. Inclusion of Montana DEQ Water Quality Division's Section 401 permit conditions, as well as other conditions, will minimize these impacts. In addition, ASARCO's proposed best management practices will be implemented to control erosion and reduce sedimentation.

3.4 Section 230.23 Current patterns and water circulation

The discharge of fill and construction of the powerline, pipelines, and access road crossings of the Rock Creek channel will modify water circulation and current patterns only at the points of discharge where the crossings of Rock Creek occur. The Rock Creek discharges will be predominantly above the creek channel and only minor impacts are expected. In addition, sound engineering and best management practices will help to minimize impacts.

Construction of the tailings paste facility will impact water patterns and circulation in the North and South Forks of Miller Gulch. Water patterns and circulation would be impacted by the temporary surface water collection channels and water management practices during paste deposition in the Miller Gulch drainage. Long-term decreased soil water infiltration rates and soil hydraulic conductivities for the paste tailings compared to native soils may alter the frequency and duration of saturation, inundation, and ponding of water for some downgradient wetlands within the Miller Gulch drainage.

3.5 Section 230.24 Normal water fluctuations

The discharge of fill associated with the construction of the powerline, pipelines, and access road crossings of the Rock Creek channel will not impact normal water fluctuations because the discharges will be predominantly above the creek channel. The construction of the tailings paste facility will impact normal water fluctuations in the Miller Gulch drainage by increased peak flows from routing the surface water around the paste disposal area. However, there is the potential that the surface water diverted around the tailings paste facility could be used to develop a wetland mitigation site in an ephemeral drainage channel of the South Fork of Miller Gulch. Higher peak surface water flows may also result from decreased soil water infiltration rates and reduced soil hydraulic conductivities for the paste tailings compared to native soils. The seepage collection system under the tailings paste disposal facility may impact natural groundwater seepage rates and could increase surface water flow rates.

3.6 Section 230.25 Salinity gradients

The Rock Creek Mine project is not expected to have any impact or effect on salinity gradients because the fill would be predominantly nonsaline materials and would be placed above the creek channel.

4.0 SUBPART D - POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

4.1 Section 230.30 Threatened and endangered species

A biological assessment (BA) of the on-site and off-site effects of the ASARCO Rock Creek mine project to threatened, endangered, and proposed wildlife species has been submitted to the USFWS (see supplemental EIS, Appendix A). The BA concludes that the proposed mine project will have no effect on Water Howellia; is not likely to adversely affect gray wolf, bald eagle, and peregrine falcon; and may adversely affect the grizzly bear. Additional information on Threatened and Endangered species is presented in Sections 2, 3, and 4 of the supplemental EIS. The USFWS will make recommendations to mitigate adverse effects that may include measures in addition to those discussed in the supplemental EIS. The USFWS will issue a formal notification prior to the final EIS.

4.2 Section 230.31 Fish, crustaceans, mollusks, and other aquatic organisms in the aquatic food web

The Rock Creek drainage supports good diversity of invertebrates but relatively low total numbers. The most common types of macroinvertebrates are clean-water forms such as mayflies, stoneflies, and caddisflies. Four species of fish have been found in the Rock Creek drainage: westslope cutthroat trout, bull trout, brook trout, and rainbow trout. Cutthroat trout and bull trout are the dominant species. Additional information on fish and aquatic organisms is presented in Sections 2, 3, and 4 of the supplemental EIS. The deposition of the tailings paste and other fill materials would affect aquatic organisms as a result of inundation, flow alterations and construction activities. Mitigating the loss of wetlands, along with implementing the best management practices and the Forest Service and state soil and water conservation practices, should minimize the impacts on fish and other aquatic organisms.

4.3. Section 230.32 Other wildlife

Terrestrial wildlife species inhabiting areas near impacted stream segments and dependent on the aquatic ecosystem would be affected by the project, especially during the construction period. However, surrounding habitat within the riparian areas would be capable of absorbing displaced individuals. Due to the relatively small area of aquatic habitat being adversely affected, relative to the total available habitat in the project area, the impacts are not considered to be significant.

5.0 SUBPART E - POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

As discussed previously, the project would result in impacts to wetlands and Waters of the U.S. habitats due to inundation, flow alterations, and construction activities. The physical, chemical, and biological integrity of the aquatic ecosystem would be modified as described in the supplemental EIS and below.

5.1 Section 230.40 Sanctuaries and refuges

There are no sanctuaries or wildlife refuges in the project area which would be impacted by the project.

5.2 Section 230.41 Wetlands

Approximately 5.6 of the total 6.2 impacted wetland acres will be filled due to the construction of the tailings paste facility (see Alternative V; Table C-2). The remaining 0.6 acres of impacted wetland and the 0.4 acres of Waters of the U.S. will be impacted due to the construction of the mill site, and the powerline, pipelines, and upgraded access road crossings of the Rock Creek channel. Wetlands impacts are discussed in more detail in Section 4 of the supplemental EIS and in the Wetland Mitigation Plan (ASARCO Incorporated 1997).

As required by Section 404(b)(1) of the Clean Water Act, ASARCO has prepared preliminary designs for wetland mitigation to specifically address Alternative V (ASARCO Incorporated 1997) (Appendix N). The mitigation plan provides for the mitigation of and compensation for the unavoidable loss and potential diminishment of the wetland functions and values associated with development of the proposed project. ASARCO identified three primary wetland mitigation areas and three optional mitigation areas (see Figure 2P in the supplemental EIS). A brief description of the primary aspects of ASARCO's wetland mitigation plan is discussed in Chapter 2 of this supplemental EIS. Detailed descriptions, including site development, design specifications, and schedules, are presented in the revised Section 3 of the Wetland Mitigation Plan (ASARCO Incorporated 1997) (Appendix N).

5.3 Section 230.42 Mud flats

There are currently no mud flats at the project site and the project will not create any.

5.4 Section 230.43 Vegetated shallows

Vegetated shallows are permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation (Emergent Palustrine wetlands). Many areas of the South Fork

Miller Gulch have characteristics which meet the wetland criteria and are classified as Emergent Palustrine wetlands. Wetlands impacts are discussed in more detail in Section 4 of the supplemental EIS and in the revised mitigation plan.

5.5 Section 230.44 Coral reefs

There are no coral reefs associated with this project.

5.6 Section 230.45 Riffle and pool complexes

Riffle and pool complexes occur within the Rock Creek channel but should have minimal impacts from the mine project. The discharge of fill associated with the construction of the powerline, pipelines, and access road crossings of the Rock Creek channel will be predominantly above the main creek channel. The South Fork Miller Gulch drainage contains no riffle and pool complexes.

6.0 SUBPART F - POTENTIAL EFFECT ON HUMAN USE CHARACTERISTICS

6.1 Section 230.50 Municipal and private water supplies

The project will not have any effect or impact on municipal or private water supplies.

6.2 Section 230.51 Recreational and commercial fisheries

The project area does not support a commercial fishery. Although there is a fishery in Rock Creek, the stream does not appear to be highly utilized. Portions of Rock Creek, primarily along the section above the confluence of Engle Creek up to the East Fork and West Fork confluence, periodically dries up in the summer months. There are no fish in the portion of the South Fork Miller Gulch.

6.3 Section 230.52 Water related recreation

The project may have a minor impact on water-related recreational uses along Rock Creek. This impact may be offset by increased recreational uses created by the wetland mitigation sites. The project could also have an impact on sightseeing excursions in the project area. While the natural beauty of the Rock Creek drainage will be forever changed, revegetation and reforestation efforts will diminish the long term effect of this impact.

6.4 Section 230.53 Aesthetics

The project will impact the aesthetic serenity of the area, particularly during the initial construction phase. Some impacts will be long term, such as the landscape change caused by the tailings paste facility structure. The visual impacts of viewing the tailings paste disposal site will depend on the time of year and the visual orientation of the viewer. Most other impacts will disappear after project completion with revegetation and restoration activities.

6.5 Section 230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves

The project area is adjacent to and under the Cabinet Mountains Wilderness Area. All aboveground project facilities would be located outside the wilderness area, except for one ventilation adit. The primary impact to the wilderness area would be one of aesthetics for wilderness users viewing the surface facilities of the project.

Six historic sites were documented during the cultural resources investigations. All of these properties were determined to be ineligible for listing on the National Register of Historic Places by consensus of the KNF and Montana State Historic Preservation Office. No mitigation measures will be necessary prior to impacting these sites.

7.0 SUBPART G - EVALUATION AND TESTING

7.1 Section 230.60 General evaluation of dredged or fill material

The tailings paste facility will be constructed using toe buttresses of rockfill (approximately 80 feet high) with paste tailings deposited from a pipeline in series of lifts and panels. A crawler crane will be used to position the paste pipeline and move the spigot locations. Successive layers of the tailings paste (1 to 4 feet in thickness) will be deposited in panels until the paste structure reaches a final height of 320 to 380 feet. The final upper surface will have some designed topographic relief created by preferential spigotting of the paste along with reshaped with a dozer.

Fill material associated with the construction of the powerline, pipelines, and access road crossings of the Rock Creek channel will be natural borrow materials from nearby mine facility disturbances. The fill materials will be placed predominantly above the main Rock Creek channel. During the construction period, water clarity in Rock Creek could be reduced due to increases in suspended solids entrained in the water column from diffuse sources. The schedule for these fill activities is presented in Table C-3.

7.2 Section 230.61 Chemical, biological, and physical evaluation and testing

Characteristics of ASARCO's Troy mine tailings solid and ASARCO's Rock Creek mine waste rock are presented in Tables 4-13 and 4-17 in Section 4 of the draft EIS. Initial testing of the tailings material indicate a net neutralizing potential (see Table 4-13). The tailings also have a low sulfide content. The results of analyses performed to date suggest that exposure of Rock Creek ore and waste rock by mining would not generate acid mine water. Additional Acid Base Accounting (ABA) would be performed during the construction of the exploration adit to ensure the adit and excavated material were not acid generating.

Drilling and blasting activities would contribute to high concentrations of suspended particulates in the adit water and mine effluent. Suspended solids contribute nearly all of the total metals load to mine effluent and must be removed. Initial removal of suspended solids could be accomplished using settling sump or sand filtration and make be performed either above or underground. Treated water will retain some dissolved metals and most of the nitrogen compounds. Mine water quality is expected to be similar to the adit water quality from ASARCO's Troy mine (see Table 4-16, Section 4 of the draft EIS). The potential for acid mine drainage exists, but is not anticipated based on available static testing data. The Troy mine may be the best predictive model available for the proposed project. No acid mine drainage has been noted at the

Troy mine during its 13-year construction and operation. If the Corps of Engineers recommend issuing a permit, they may attach permit conditions requiring ASARCO to have a contingency operational plan in the event that acid drainage occurs.

8.0 SUBPART H - ACTIONS TO MINIMIZE ADVERSE EFFECTS

Project impacts which would affect wetlands or Waters of the U.S. are addressed in the following text, in accordance with the 404(b)(1) guidelines. Appropriate and practicable steps to minimize potential adverse impacts on the aquatic ecosystem have been developed and are addressed in the alternatives analyses in Section 4 of both the draft EIS and supplemental EIS. Wetlands and Waters of the U.S. will be affected by the proposed project (see Table C-2). None of the alternatives would affect more than 1.5 acres of Waters of the U.S. Variable amounts of wetlands are affected but no more than 8.1 acres under any alternative.

ASARCO Rock Creek mining project will employ a number of best management construction methods to help prevent erosion and decrease sedimentation during construction activities. Methods may include using silt fencing wherever appropriate, diverting water flows around work areas, suppressing dust emissions during dry periods, and salvaging hydric soils from under the tailings impoundment for use in revegetation operations.

A revised wetland mitigation plan has been prepared by ASARCO specifically to address Alternative V (ASARCO Incorporated 1997). The revised wetland mitigation plan is provided in Appendix N, summarized in Chapter 2 of this supplemental EIS, and discussed in the various sections of this preliminary 404(b)(1) Showing.

8.1 Section 230.70 Actions concerning the location of the discharge

The Rock Creek proposed tailings paste disposal site was chosen from several alternative locations for environmental as well as engineering reasons. In the Agencies opinion, the Rock Creek location appears to be the least environmentally damaging practicable alternative site for a tailings impoundment. The Rock Creek location will result in less destruction of wetlands and Waters of the U.S. than the McKay Creek impoundment site. The implementation of construction's best management practices will be employed to minimize soil erosion and sedimentation, and dust emissions during project activities.

The locations of the confluence mill site and the powerline, pipelines, and access road crossings of Rock Creek are being designed to avoid and minimize direct and indirect impacts to wetland and Waters of the U.S. Design and operational limitations are constrained by the mountainous topography, stream channel location, and the size of the mining related facilities. The proposed and alternate locations for these facilities are discussed in ASARCO's Wetland Report (ASARCO Incorporated 1997).

An increase in the suspended particulates and turbidity in the Waters of the U.S. (Rock Creek channel) and water flowing through the delineated wetlands will occur during fill (construction) activities. Of primary concern for the lower portion of Rock Creek, is the potential impact of increased sedimentation on Bull trout spawning. The Bull trout spawns in depositional areas and increased sedimentation could have a significant impact on their reproduction rates. Erosion control measures are described in detail throughout the Rock Creek Mine permit application. These measures involve mechanical practices, soil-handling techniques to enhance stability, hydrologic measures to control runoff and sedimentation, and revegetation practices to provide a stabilizing cover. With the inclusion of these best management practices and the Forest

Service and state soil and water conservation practices, any increase in the suspended particulates and turbidity in Rock Creek should not have a significant impact on the fishery.

8.2 Section 230.71 Actions concerning the material to be discharged

Very little can be done to change the physical nature of the tailings paste material to be discharged. The tailings paste water content, additions of thickening agents, and thickness of the successive paste layers can be controlled to minimize the volume of tailings water to be rehandled and to ensure paste panel stability. Borrow materials used for the construction of the Rock Creek utility crossings will be similar to the natural alluvial materials in the vicinity.

8.3 Section 230.72 Actions controlling the material after discharge

The tailings paste disposal facility structure has been designed to fully contain all tailings paste materials. A tailings paste underdrain seepage collection system, consisting of underdrains and collection lines, will be constructed to minimize the potential contamination of ground water resources. Intercepted tailings paste seepage water would be returned to the impoundment.

Interim revegetation and stabilization would take place on all filled areas, along Rock Creek, that are associated with construction activities at the confluence mill site and the powerline, pipelines, and access road crossings of Rock Creek. The areas would be broadcast seeded, or hydroseeded, mulched, and fertilized.

8.4 Section 230.73 Actions affecting the method of dispersion

The wetland areas under the tailings paste disposal area will be completely covered by the proposed discharge. The tailings paste facility will be constructed using toe buttresses of rockfill (approximately 80 feet high) with paste tailings deposited from a pipeline in series of lifts and panels. A crawler crane will be used to position the paste pipeline and move the spigot locations. Successive layers of the tailings paste (1 to 4 feet in thickness) will be deposited in panels until the paste structure reaches a final height of 320 to 380 feet. The final upper surface will have some designed topographic relief created by preferential spigotting of the paste along with reshaped with a dozer. The implementation of best management practices during the salvaging of topsoil, construction of the toe buttresses, and construction of other project facilities will minimize the release and dispersion of any discharged materials off site.

8.5 Section 230.74 Actions related to technology

The implementation of best management techniques during construction to minimize any adverse environmental impacts would help to minimize adverse environmental impacts. Tailings paste slurry would be transported above ground via twin 10-inch, urethane-lines, high-pressure, steel pipelines to the impoundment for disposal. The lines would be encased in a larger steel pipe at the Rock Creek crossings to guard against spillage. Small emergency dump ponds would be excavated at the stream crossings, to contain potential spillage. Routine monitoring and inspection of the pipeline for leakage or breaks will be performed.

Hydric soils will be salvaged from the 4.6 acres of wetlands under the proposed impoundment and directly respread on the Miller Gulch wetland mitigation sites to provide increased organic matter and a plant materials source. Clay sealants or polyvinyl chloride (PVC) liners may be used to reduce deep percolation of water at the wetland mitigation sites, however there need is not expected.

8.6 Section 230.75 Actions affecting plant and animal populations

All plant populations in the tailings paste disposal area will be lost, while animal populations will be displaced or lost as a result of construction activities. Reclamation activities will, upon completion, replace some of the lost habitat and provide space for the reestablishment of some of the lost plant and animal populations. In addition, in the event a 404 permit is approved and issued, permit conditions and additional mitigation measures may be incorporated into the 404 permit to ensure the project complies with Section 230.10(d) of the guidelines. ASARCO has proposed wetland mitigation to offset adverse impacts and provide reasonable mitigation for the loss of wildlife habitat.

8.7 Section 230.76 Actions affecting human use

The Rock Creek tailings paste disposal site was selected because it appears to be the least damaging to the aquatic ecosystem of the tailings disposal alternatives. While the project will have a permanent negative effect on the aesthetics of the area, reclamation activities upon project completion and the planting of visual screening, will minimize the overall visual impact. The completed project is not expected to increase human activities in the area which are incompatible with current use patterns. The tailings paste disposal is not expected to have any effect or impact on any public water supply intake.

Acid mine drainage is not expected to occur as a result of the tailings paste disposal. This opinion is based on 13 years of tailings impoundment water quality data from the Troy mine, and initial net neutralizing potential testing (acid-base potential) of the Rock Creek waste rock and tailings (see Tables 4-13 and 4-17 of the draft EIS). Following mining operations, ASARCO would monitor water quality in the vicinity of the tailings paste facility. If the Corps of Engineers recommend issuing a permit, they may attach permit conditions requiring ASARCO to have a contingency operational plan in the event that acid drainage occurs.

8.8 Section 230.77 Other actions

The design and contours of the final tailings paste surface, implementation of best management practices during construction and operations, and planned reclamation activities will minimize or eliminate any adverse environmental impacts which could be expected from future runoff or other discharges from activities to be conducted on the fill. The mitigation measures incorporated into this project are expected to offset any adverse environmental impacts caused by the discharge of fill material into Rock Creek, North and South Forks of Miller Gulch, and the adjacent wetlands.

9.0 PRELIMINARY CONCLUSIONS

The proposed ASARCO Rock Creek mining project has been reviewed relative to the Section 404(b)(1) Guidelines and the Agencies have concluded the mining project will result in impacts to circulation and fluctuation patterns, substrate, suspended particulates/turbidity, water quality, and aquatic ecosystem structure and function. Several of these impacts will be permanent and long-term while others will occur primarily during the construction period and will be short-term. Cumulative effects from other mining activities, timber harvesting, and other forest related activities will be evaluated and considered prior to making the final permitting decision.

In the Corps of Engineers review of the project, all the alternatives considered in the Final EIS will be reviewed and evaluated to determine if there is a least damaging practicable alternative that could be permitted. Public interest factors, input from other state and federal agencies, and the proposed mitigation measures will also be considered by the Corps of Engineers in the evaluation process prior to their making a final permitting determination.

At the earliest, a final 404 permit evaluation cannot be made by the Corps of Engineers until 30 days after the Final EIS is published. However, based on the size and complexity of this project, the required detailed evaluation, and the preparation of required supporting documentation, the Corps of Engineers Final 404 permit evaluation will most likely not be completed until several months after the Final EIS is published.

TABLE C-1
Affected Acreage of Wetlands and Waters of the U.S. by Mining Alternatives

	Affected Acreage (Direct + Indirect)		
Mining Alternative	**Wetlands**	**Waters of the U.S.**	**Total Acres**
Alternative I - No Action	0	0	0
Alternative II - ASARCO Proposed Project	8.1	1.5	9.6
Alternative III - Proposed Project with modifications and mitigations	6.2	1.5	7.7
Alternative IV - Modified Rock Creek Project with mitigations	6.2	0.4	6.6
Alternative V - Rock Creek Project with Tailings Paste Deposition and Alternative Water Treatment	6.2	0.4	6.6

TABLE C-2
Acreage of Wetlands and Waters of the U.S. Affected by Proposed and Alternative Facilities

ALTERNATIVE IMPACTS	Wetlands (acres)		Waters of the U.S. (acres)	
	Direct	**Indirect**	**Direct**	**Indirect**
ALTERNATIVE II				
ASARCO mill site area	0.3	0.0	1.1	0.0
ASARCO mill site waste rock dump	0.6	1.3	0.0	0.0
Access road upgrade (FDR No. 150)	<0.1[1]	0.0	<0.1	0.0
Utilities corridor (powerline/pipelines)	0.2	0.0	0.3	0.0
Rock Creek tailings impoundment	4.4	1.0	0.0	0.0
Topsoil stockpiles and diversion ditches	<0.1	0.0	0.0	0.0
Excess mine water pipeline	<0.1	0.0	0.0	0.0
Alternative II Totals	**5.8**	**2.3**	**1.5**	**0.0**
ALTERNATIVE III				
Alternative III Totals	**5.2**	**1.0**	**1.5**	**0.0**
ALTERNATIVE IV				
Alternative IV Totals	**5.2**	**1.0**	**0.4**	**0.0**
ALTERNATIVE V				
Confluence Mill Site and Waste Rock Dump	<0.1	0.0	0.0	0.0
Access road upgrade (FDR No. 150)	<0.1	0.0	<0.1	0.0
Utilities corridor (powerline/pipelines)	0.2	0.0	0.3	0.0
Wet Paste Tailing Disposal	4.6	1.0	0.0	0.0
Topsoil stockpiles and diversion ditches	<0.1	0.0	0.0	0.0
Excess mine water pipeline	<0.1	0.0	0.0	0.0
Alternative V Totals	**5.2**	**1.0**	**0.4**	**0.0**

[1] <0.1 acres rounded up to 0.1 acres for acreage totals

TABLE C-3
Fill Material Sites, Amounts, Types, Times, and Duration for the ASARCO Rock Creek Mine

Fill Site	Fill Amount[1] (Cubic Yards)	Type of Fill	Time and Duration (Project Year)
Utilities corridor	0		
Excess mine water pipeline	0		
Access road upgrade	800	On-site borrow	1
Mill site, patio, facilities, and roads	300,000	Waste rock and on-site borrow	2 - 5
Topsoil stockpile and diversion ditches	430,000	Topsoil and subsoil	1
Waste rock dump	444,500	Mine waste rock	2 - 5
Tailings impoundment (Including paste disposal alternative)	82,304,500 735,000	Tailings (paste) Waste rock, rock, and on-site borrow	4 - 30 1

Note:

[1] It was not possible to identify the specific amount of fill to wetlands and Waters of the U.S. for these sites containing large quantities of fill. Fill amounts are total amounts for that activity, and not the amounts specific to the wetlands and Waters of the U.S. portions of the sites.

TABLE C-4.
Tailings Impoundment Siting Alternative Summary

Site	Construction Option	Reason Dismissed from Further Consideration	Reference
Rock Creek (MAC Report Site 12)	Not Applicable	Insufficient capacity	MAC Report (USFS 1986)
Rock Creek (MAC Report Site 11A, ASARCO proposed site)	Downstream Method	Excessive amount of borrow required (40 million cubic yards).	Thompson 1989
Noxon Bench (MAC Report Site 10)	Upstream Method	Tailings & reclaim water pipelines crossing the Clark Fork River.	Thompson 1989
Noxon Bench (MAC Report Site 10)	Downstream Method	Tailings & reclaim water pipelines crossing the Clark Fork River. Excessive amount of borrow required (35 million cubic yards).	Thompson 1989
Swamp Creek (MAC Report Site 21)	Upstream Method	Tailings & reclaim water pipelines twice as long as needed for the Rock Creek site. Disturbance area 200 acres larger than for the Rock Creek site. Site is privately owned and would require removal of residences. No distinct advantages over the Rock Creek Site.	Thompson 1989
Swamp Creek (MAC Report Site 21)	Downstream Method	Same as upstream. Excessive amount of borrow required (10 million cubic yards).	Thompson 1989
Swamp Creek/Rock Creek Combined Site	Downstream Method	Same as for Swamp Creek. Total disturbance area of approximately 700 acres .	Thompson 1989
Noxon Bench/Rock Creek	Downstream Method	Same as for Noxon Bench. Total disturbance area of approximately 700 acres.	Thompson 1989
McKay Creek	Downstream Method	Greater impact to Waters of U.S. and wetlands and diversion of a perennial stream.	Thompson 1989

TABLE C-5
Proposed Acreage and Schedule[1] for Created Wetlands

WETLAND MITIGATION SITES	CREATED ACREAGE	SITE CONSTRUCTION	PROJECTED RESUMPTION OF COMPARABLE FUNCTIONS
Miller Gulch Tributary	1.2	Preproduction Year 3	Production Year 22
Lower Rock Creek	1.4	Preproduction Year 5	Production Year 3
Upper Rock Creek			
Stage 1	1.1	Preproduction Year 1	Preproduction Year 4
Stage 2	3.3	Preproduction Year 3	Production Year 1
TOTAL WETLAND MITIGATION	**7.0**		

Note:
[1] Schedule based on 5 years preproduction activity, 30 years production, and 5 years post-production closure and reclamation.

(TO BE MAILED 9/29/97)

APPENDIX F

DESCRIPTION OF REAGENTS

APPENDIX F - DESCRIPTION OF REAGENTS

Table F-1 lists reagents used in the mill process and their estimated annual consumption. Table F-2 describes reagent handling. (ASARCO 1986-87:Vol. 2, Part 1, pp. 26-29)

Table F-1: Description of Reagents

Reagent	Purpose	Addition Point	Annual Consumption (Pounds)	Pounds Per Ton Ore
Xanthate	Flotation Collector	Primary Ball Mills Regrind Mill, All Flotation	216,000	0.06
Yarmor-F Pine Oil	Frother	All Flotation	54,000	0.015
Dow 250	Frother	All Flotation	10,800	0.003
Am Cy Superfloc S-5595	Flocculant	Concentrate and Tailings Thickener	108,000	0.03
Orzana A*	Binder	Railroad Cars of Concentrate	10,800	0.003

* Not needed under Alt. V

Table F-2: Handling of Reagents

Reagent	Delivery	Storage	Mixing Facility
Xanthate	Truck	275, 300 and 330 lb. drums	6' x 6' mixing tank 6' x 6' storage tank
Yarmor-F Pine Oil	Tank Truck	8,000 gallon storage tank	6' x 6' mixing tank
Dow 250	Truck	450 lb. drums	Mixed with pine oil to 15% solution
Am Cy Superfloc S-5595	Tank Truck	2,300 gallon storage tank	4,500 gallon mixing tank
Orzana A Binder *	Truck	50 lb. bags	3' x 6' mixing tank
Nalco 84DC225	Truck	571 lb. drums	None; direct addition

* Not needed under Alt. V

Chemical Composition of Reagents

Potassium amyl xanthate: C_5H_{11} - O - CS - SK^+
Yarmor F pine oil (terpene): Mostly a mixture of $C_{10}H_{18}OH$ and $C_{10}H_{16}$.
Dow 250: Polypropylene glycol methyl ether: CH_3 - $(O\text{-}C_3H_6)_N$ - OH
N = $8\text{-}10^3$
Ammonium Cyanide Superfloc S-5595: Anionic polyacrylamide copolymer.
Orzana A: Ammonium lignosulfonate.

Toxicity of Process Reagents	Process Reagent	Aquatic Toxicity
Xanthate	Poisonous when absorbed through the skin, inhaled, or swallowed.	Moderately toxic to rainbow trout
Yarmor-F-Pine Oil	Not considered to be toxic but can cause irrigation to skin and mucous membranes, headaches, and palpitations if inhaled, and should not be ingested.	Moderately toxic to rainbow trout
Dow 250	Is not considered to be toxic but may cause moderate eye irritation and should not be ingested. Does not vaporize significantly at room temperature.	Relatively non-toxic to rainbow trout
Am Cy Superfloc S-5595	May irritate skin on contact. It is poisonous if ingested and the solvent vapors may cause chemical pneumonia. Minimal eye irritation may also result from contact.	Moderately toxic to rainbow trout
Orzana A	Not regarded as toxic. Inhalation and contact with skin and eyes should be avoided	Relatively non-toxic to rainbow trout

Spill Procedures for Process Reagents

Xanthate:

Spillage would be diluted with water and returned to the process. No drains in the reagent mixing and storage areas would permit release of spills outside the complex.

Yarmor-F Pine Oil:
Spills would be flushed with water and returned to the process.

Dow 250:
Spills would be diluted with water and returned to the process.

Am Cy Superfloc S-5595:
Spillage would be absorbed with a commercial absorbent and shoveled into waste cans to await permanent disposal.

Orzana A:
Spills would be swept with other contaminated material and shoveled into waste cans to await permanent disposal.

Exposure Limits to Flotation and Process Reagents for Employees

Reagents used in the extraction process are all commonly employed in flotation recovery plants worldwide. They are received either as liquids diluted with water or added directly to the process, or as solids diluted with water or added directly (e.g., Xanthate and Orzana A).

Depending on toxicity of the reagent, employees who mix reagents would be required to wear rubber gloves, aprons, dust masks or respirators, and safety glasses or full face shields. The plant would be designed to store reagents in clean, dry areas away from heat and sources of ignition. Handling and mixing facilities would be separate.

No gases are to be used in processes within the complex. The American Conference of Governmental and Industrial Hygienists (ACGIH) has issued Threshold Limit Values (TLV)[1] for Chemical Substances and Physical Agents in the Work Environment (1983-84). Of the reagents proposed, none have established TLVs. Therefore, employee exposure would be governed by suppliers' recommended procedures as outlined in various "Material Safety Data Sheets."

Behavior of Reagents in the Process

Xanthate:
Used as collectors in the flotation process, xanthates attach to sulfide particles and remain with the concentrates. Negligible quantities would go into the tailings or paste.

Pine Oil and Dow 250:
These two reagents are mixed into a frother solution throughout the flotation process to maintain a stable froth bed. They would remain with the concentrates or degrade in the process circuit. Negligible amounts would go into tailings or paste.

[1]TLV/TWA-Time weighted average concentration for a normal 8-hour work day and 40-hour work week, to which nearly all workers may be exposed, daily, without adverse effect.

Am Cy Superfloc S-5595:

This reagent is used in the concentrate and final tailings thickeners to settle suspended solids. The fraction used in the concentrate thickener would remain with the concentrate. The fraction fed to the final tailings thickener would go with solids to the tailings impoundment as a highly sheared (decomposed) hydrocarbon.

Orzana A:

This reagent is used at the railroad siding where final concentrates are shipped for sale. It is used as a glue to control dust losses of concentrate during transit and remains entirely with the concentrates.

APPENDIX H

AGENCIES' CONCEPTUAL MONITORING PLANS

INTRODUCTION

This appendix contains the Agency-modified or -generated conceptual monitoring plans for alternatives III through V. ASARCO would develop a final monitoring plan for approval by the Agencies prior to project startup. All plans would need to identify trigger or alert levels, which, when reached, would require ASARCO to implement a corrective action plan. Corrective action plans for the most likely scenarios also need to be developed and approved prior to project startup.

Reporting

All monitoring would require an annual report unless otherwise specified. The format and requirement needs for reporting would be reviewed and finalized by the Agencies. Reports would be submitted to other review agencies as identified by KNF and DSL.

After submittal of a monitoring report, the Agencies may call a meeting with all other relevant agencies to review the monitoring plan and results, and to evaluate possible modifications to the plan or permitted operations.

AIR QUALITY MONITORING PLAN

Ambient air quality monitoring would be required as a condition of the air quality permit for the project. This most likely would include three to four particulate monitoring sites in the vicinity of the plant and tailings areas and a meteorological (wind speed and direction) monitoring system. All monitoring must be performed according to state and federal quality assurance procedures.

Performance testing (measurement of the particulate emission rate) on the wet scrubber controlling emissions from the secondary crusher would also be required to verify compliance with the applicable emission standard (0.05 grams per dry standard cubic meter). Following the initial tests, operational parameters of the scrubber would be monitored on an ongoing basis. These parameters include scrubbing liquid flowrate and the change in pressure of the gas stream through the scrubber.

Air Quality Division personnel would perform on-site inspections of the operation on a random basis on a frequency of at least once per year. Air monitoring reports would be submitted and reviewed on a quarterly basis. The overall effectiveness of the proposed air pollution control measures, with emphasis on the adequacy of wind erosion prevention at the tailings impoundment, would be evaluated in this way on an ongoing basis. Standard quality assurance/quality control procedures for air monitoring programs would be implemented as a condition of the air quality permit.

GEOCHEMICAL CHARACTERIZATION AND MONITORING PLAN

ASARCO would provide an agency-approved geochemical characterization and monitoring plan. The final approved plan would be in place prior to beginning the evaluation adit and would contain specific information on sample locations, tests to be performed, chemical parameters for analysis, laboratory detection limits, frequency of data collection, and reporting requirements.

The plan would target rock materials encountered during construction of the evaluation adit and would include all rock types and mineral zones encountered. The aim would be to characterize project waste rock, ore remaining underground, and tailings as to their potential to form acid rock drainage and their potential oxidize under neutral pH conditions and leach metals. Characterization would include static tests, kinetic tests, and handling and materials management methods. The characterization and management plan would include recommendations from Klohn-Crippen (1997) as determined by the Agencies.

The plan would contain an estimate of total tonnage of waste rock to be produced from the different mineral zones and rock types, associated geochemical characteristics, and their planned storage locations. This estimate would be updated biannually (twice yearly) to reflect test results. The plan would include trigger values that would require, when exceeded, special handling and disposal.

It would also include a plan for continued monitoring during general mine operation and closure, with reporting on a biennial basis (every two years) unless trigger values were exceeded, at which time reporting would change to biannual (twice yearly). Reporting would remain biannual until adequate mine plan design changes had been agreed to by the Agencies and implemented by ASARCO.

WATER RESOURCES MONITORING PLAN

Introduction

This plan provides the conceptual framework necessary for development of a water resources monitoring program for the ASARCO Rock Creek Project. ASARCO submitted its own version of a water resources monitoring plan, however, the Agencies believe that several important elements were missing from this plan.

Only a final Agency-approved monitoring plan would be implemented. The final approved plan would contain specific information on sample location, chemical parameters for analysis, laboratory detection limits, frequency of data collection, and reporting requirements. The water resources monitoring program would begin during the first quarter of construction of the evaluation adit, and would be maintained during the life of the project as well as after reclamation for a period of time to be specified by the Agencies.

The goals of the water resource monitoring are:

- to quantify any measurable environmental impacts accompanying construction, operation, or reclamation of the ASARCO Rock Creek project;
- to evaluate the accuracy of impacts described in the EIS; and
- to determine whether alterations of project operations or additional mitigative actions are required to correct any unanticipated impacts encountered, or to prevent future violations of regulatory requirements.

A comprehensive monitoring system network would be established to evaluate potential impacts associated with the underground mine, mill, utility corridor, water treatment facility, and tailings impoundment. Data would be collected and evaluated in detail using standard statistical analyses to determine if differences exist between:

- an upstream (or upgradient) reference station and the corresponding downstream station;

- sampling intervals (monthly, quarterly, annually);
- high and low flow events.

Operational data would also be compared to data collected during baseline conditions to document changes in water quality.

This conceptual monitoring plan is divided into several elements:

- surface water monitoring
- ground water monitoring
- facility water balance and chemistry
- analytical parameters and methods
- quality assurance and quality control program
- remedial action plan
- reporting

These elements are discussed in detail below.

Surface Water Monitoring

Surface water quality samples would be collected and analyzed during the construction, operation, and reclamation phases of the proposed project on a quarterly basis. Water samples would also be collected during temporary facility shutdowns or mine closure. Surface water stations would be located on the East and West forks of Rock Creek, the mainstem of Rock Creek, Miller Gulch, the Clark Fork River and other locations as determined by the Agencies. Sampling locations would be coordinated with the aquatic monitoring program. The surface water monitoring program, including the location of all stations evaluated during the baseline data collection program, would be finalized based on Agency review and approval. The rationale and requirements for monitoring surface water resources at specific stations during the construction, operation, and reclamation phases of the proposed project would be discussed in ASARCO's final water resources monitoring plan.

Monitoring of lake levels at Cliff and Copper lakes would also be part of the surface water monitoring program. This plan would be coordinated with the aquatics monitoring plan and wetlands monitoring and mitigation plans.

Ground Water Monitoring

Ground water monitoring data would be collected on a quarterly basis during construction, operation, and reclamation phases, as well as during temporary facility shutdowns. Ground water would be monitored in the underground mine, upgradient and downgradient of the mill, upgradient and downgradient of the proposed tailings impoundment, and from the tailings impoundment perimeter pump-back well system. In addition, flow and quality of springs and seeps would be monitored, with particular emphasis on those sources of water that provide recharge to Rock Creek. Monitoring well and perimeter pump-back well locations, and sampling frequency would be reviewed and finalized after consultation with the Agencies. Water quality and water level data from monitoring wells and static water level data from piezometers would be collected. Static water level data from piezometers located along the perimeter of the tailings impoundment would be critical to evaluate potential seepage impacts to ground water or surface water

resources. Ground water from all existing domestic water supply wells downgradient of the proposed tailings impoundment would also be collected and analyzed.

Split samples from monitoring and domestic wells would be periodically collected and analyzed by DHES to verify ASARCO's data. Split samples from domestic wells would be offered to owners. The Agencies would consider the actual facility water balance data, estimates of seepage, and results of the ongoing ground water monitoring program in determining how long monitoring of private domestic water supply wells should continue. At a minimum, ground water quality sampling and analysis would continue at least until bond release.

Facility Water Balance and Chemistry

A detailed facility water balance and analysis of water and waste water chemistry would be maintained, the details of which would be specified in the final water resources monitoring plan. The purpose of the facility water balance would be to provide an assessment of the inflow, outflow, and general water or waste water chemistry associated with the underground mine, water treatment facility, and tailings impoundment. Monitoring information would be used to modify, as necessary, operational water handling, and to develop a post-mining water management plan. As part of this monitoring, the following aspects of the project water balance would be measured:

- the volume of excess water stored underground
- mine reservoir water quality
- mine adit discharge and water quality
- the amount of tailings slurried or deposited as a paste
- the amount and source(s) of fresh makeup water to the mill
- the amount of reclaimed tailings water returned to the mill
- the water quality of tailings decant water
- the amount and quality of water pumped from the seepage collection ponds
- treatment facility influent flow and water quality
- flow rate and quality of water discharged to the Clark Fork River
- the amount and source of water used for dust suppression and irrigation
- the amount and source of water discharged to any land application disposal areas
- pan evaporation and precipitation data at the tailings impoundment site

Parameters and Analytical Methods

At a minimum, the 21 parameters evaluated in the EIS would be retained for analysis in the water resources monitoring program. All water samples would be analyzed using procedures with the lowest possible laboratory analytical detection limits, and using procedures described in 40 CFR 136, EPA-600/4-79-020, or methods shown to be equivalent. Collection, storage, and preservation of water samples would be in accordance with EPA procedures (EPA-600/4-4-82-029). Grab samples would be collected from streams and ground water samples would be obtained with a bailer or submersible pump. Samples would be cooled immediately after collection. Metals in water samples would be preserved by adding nitric acid in the field to lower the pH to less than 2.0. Ground water samples for metals analysis would be filtered through A 0.45 micron filter to allow measurement of dissolved constituents. All field procedures would be consistent with procedures in the U.S. Geological Survey's National Handbook of Recommended Methods for Water-Data Acquisition.

These parameters would initially be retained within the monitoring program. Subsequent to review of data collected during the initial years of the project, continued testing for the full parameter list may be restricted to analyses of mine and tailing deposit effluent before and after treatment. It is likely that other ambient monitoring sites would be routinely analyzed only for contaminants likely to be released by the mining operation, including at a minimum physical parameters and common ions, nutrients (including ammonia, nitrate, and phosphate), and the following metals: copper, lead, zinc, antimony, and manganese. Other metals may be retained in the ambient water quality monitoring program, depending on actual chemistry of mine and tailings water. Effluent from the mine and water recovered from the tailings would be required to be analyzed for the full parameter list, and for both dissolved and total recoverable metals.

Quality Assurance/Quality Control Program

Quality assurance (QA) assures the integrity and reliability of monitoring and measurement data. Quality control (QC) is the application of procedures to evaluate data acquisition techniques and analyses according to established criteria. QC procedures define whether sampling and analytical techniques are in or out of control with reference to applied standards and control limits.

A specific QA/QC program would be approved by the Agencies to guarantee the quality and source of all data collected. This program would include sample documentation, as well as sample control and data validation.

The documentation and sample control portion of the QA/QC plan would be designed to document and track samples from the time of collection through reporting of analytical results. Elements in this portion of the plan include sample identification protocol, the use of standardized field forms to record all field data and activities, and the use of chain-of-custody sample tracking and analysis request forms.

The purpose of data validation would be to ensure that data collected during the monitoring phase would be of known and acceptable quality. Quality control samples would include blind field standards, field cross-contamination blanks, and replicate samples.

Monitoring Alert Levels and Contingency/Corrective Action Plan

As part of this water resources monitoring plan, a monitoring alert levels and contingency/corrective action plan would be developed for the Rock Creek Project. Elements of the plan would include, but not be limited to the following:

- Adit water monitoring and contingencies for possible long-term post-closure adit water treatment;
- Geochemical assessment of waste rock and contingencies for possible production of leachate;
- Long-term monitoring and contingencies for possible uncontrolled discharge of drainage of contaminated water from sumps, waste rock used for construction, paste tailings deposit, process and paste tailings storage ponds, adit leaks and adit plug failures, seepage from the underground mine workings; and
- Long-term monitoring of Cliff and Copper Lakes.

Remedial Action Plan

As part of this water resource monitoring plan, a remedial action plan would be developed for the Rock Creek project. Objectives of the remedial action plan would be:

- to define remedial action criteria and statistically based methods for determining whether significant impacts to surface or ground water resources occur during the project's construction, operation, and reclamation phases;
- to identify key players and their respective roles and responsibilities for implementing the remedial action plan;
- to identify, illustrate, and schedule the decision-making process associated with remedial actions; and
- to prepare a list of potential remedial action alternatives for various degradation scenarios.

Reporting

ASARCO would prepare quarterly and annual reports to summarize information and data obtained during implementation of the ASARCO Rock Creek water monitoring program. The report would include data tabulations, analysis of trends, statistical computations, maps, cross sections, and diagrams needed to clearly describe hydrologic conditions. ASARCO would also submit computerized data and analyses in a format acceptable to the Agencies.

WILDLIFE MONITORING PROGRAM

Monitoring plans would be developed for several wildlife subjects based on the conceptual plans provided below. Monitoring plans would vary depending upon the species or subject being monitored.

In some cases, monitoring would occur on subjects for which insufficient baseline data exist to fully estimate potential impacts or changes. Monitoring would identify the status of these subjects during or after mining activities but the data would not be compared with inadequate premine data.

Currently, the Forest Service and DFWP are developing or implementing monitoring plans or studies for some species or subjects. Where feasible and appropriate, ASARCO would contribute funding to these efforts in place of initiating a separate and redundant monitoring activity.

The goal of the wildlife monitoring program is to determine project-related impacts on existing wildlife populations. If impacts were identified, then appropriate remedial action plans would be developed and implemented. This monitoring program would be started during the first quarter of exploration adit construction and would be comprised of monitoring and reporting for the following elements:

- neotropical migrant bird;
- mountain goat;
- sensitive animal species; and
- road closure.

Neotropical Migrant Bird Monitoring

This plan would coordinate with current programs in place or initiated by state and federal agencies and private organizations. The goal of this monitoring would be to gain additional information about

neotropical migrant birds, population trends, species composition changes, and their responses to mine-related impacts.

Mountain Goat Monitoring

Mountain goats would be monitored for their responses to mine-related impacts. Limited baseline data would hinder comparisons of premine status with mine-life or post-mine status. However, information gained would be useful in determining population trends, habitat use, and to some extent mine-related impacts. The monitoring plan would integrate aspects of a mountain goat monitoring plan/study that has already been developed by DFWP. The plan would need to specify the sampling and analysis methods to be used and would be reviewed and approved by the Agencies.

Sensitive Animal Species Monitoring

A forest-wide monitoring program for sensitive species including harlequin ducks is currently being implemented by KNF. ASARCO would contribute funding to this existing effort. The goal of this monitoring item would be to gain more information about sensitive species, habitat use, and mine-related impacts.

Road Closure Monitoring

Road closures would be monitored for their effectiveness in excluding motorized access. This would include assessing KNF administrative and unauthorized road use and the ultimate effectiveness of closure. This monitoring plan would take into account road closures proposed for grizzly bear mitigation as well as existing road closures. The plan would be developed in coordination with KNF.

AQUATICS/FISHERIES MONITORING PLAN

Introduction

A detailed monitoring plan is available in the project file at DSL (dated November 18, 1994). The following is a summary of the highlights of that plan.

The primary reason for monitoring aquatic biota is to determine if mine project activities cause impacts to aquatic resources. Aquatic macroinvertebrates[1] are one of the most reliable organisms to monitor for water quality because they are almost always present in a stream under a wide range of conditions, from clean to polluted. In contrast, fish are more difficult to monitor on a regular basis because they are not found in all drainages, can be transient within a reach, excluded from areas by physical barriers (e.g., waterfalls), and generally have more limited habitat requirements. Aquatic monitoring serves the following additional functions:

- determines whether BMPs and other mitigation are working (e.g., is sediment being effectively controlled from roadway activities?).

[1]Aquatic organisms, such as insects or worms, that inhabit stream bottoms.

- documents the presence of aquatic macroinvertebrates and periphyton[2] in the stream reflecting the short- and long-term quality of the water and sediments. In contrast, water samples, collected only at a specific time, may miss potential pollution events between sampling. Certain species can tolerate polluted conditions (e.g., metals, fine sediments) while others only exist in clean waters.
- determines whether aquatic life standards are successful at protecting the resident aquatic life.
- detects (periphyton monitoring) effects of nutrient loading (e.g., nitrate residues from blasting agents) to a stream.

Aquatics and fisheries monitoring would be required to determine if impacts occur to these resources. ASARCO would need to monitor benthic macroinvertebrates, fine sediments, periphyton, fish populations, and metals accumulations in fish tissues. The timing and location of aquatic biological monitoring should be coordinated with the surface water quality monitoring program (Klemm et al. 1990). Monitoring would begin during the first quarter of exploration adit construction and continue through postmining reclamation.

ASARCO would compare data collected from the monitoring stations to that collected during preconstruction baseline studies. In addition, data collected from potential impact sampling stations also would be compared to upstream reference stations. The monitoring plan may be modified by the agencies in response to the information collected to reflect concerns specific to the construction, operation, and postoperational time periods.

In the event of a temporary mine closure, monitoring would continue unless the agencies agreed to reduce or suspend monitoring requirements.

Benthic Macroinvertebrates

ASARCO would maintain detailed maps and photographs of each sampling site so that the sties can be accurately relocated each year. In addition, permanent markers would be installed at each study site.

Quantitative macroinvertebrate data would be collected three times per year at approximately ten sampling stations. Sampling stations would be selected to represent a range of impacted and unimpacted conditions. In order to reduce variability, sampling areas should be restricted to those of a similar physical nature as much as possible (Klemm et al. 1990). It may be necessary to locate a suitable reference station outside the Rock Creek drainage. Samples would be taken in a quantity and manner approved by the Agencies. If possible, sampling would be done in the same or similar manner as the baseline samples.

Data analysis techniques would include, but are not limited to, the following:

- standing crop
- taxa richness
- percent dominant taxon
- ratio of functional feeding groups
- Shannon-Weaver diversity index
- equitability (Lloyd and Bhelardi 1964)

[2]Algae attached to submerged surfaces such as rocks or logs.

- community similarity index
- pollution tolerance indices
- EPT/C (total mayflies, stoneflies, and caddisflies divided by total chironomids)
- EPT abundance and richness

Data would be compiled by season and comparisons would be made between potential impact sites and reference sites. Data would also be compared with baseline data.

In addition, bioassays would be conducted with water samples taken from locations to be specified by the Agencies. Likely sampling locations are the mine adit waste water, tailings impoundment seepage water, and Rock Creek water downstream of the mill site. Test animals would be selected by the Agencies prior to the start of monitoring.

Fine Sediments

Fine sediment loading of spawning gravels in Rock Creek would be estimated using at least two different sediment analysis techniques[3] at a variety of sampling stations within the drainage. Sampling techniques, times, and locations were to be approved by the Agencies prior to the start of monitoring.

Periphyton

Monitoring would be done at the same times and locations as the benthic macroinvertebrates sampling, unless otherwise specified by the Agencies. Sample collection, processing, and analysis techniques (Protocol II, control site protocol) as described in Bahls (1993) would be used.

[3]Recommended methods include substrate score and McNeil Core substrate sampling methods.

Fish Populations

Fish populations in Rock Creek would be monitored at 2-year intervals at a variety of stream reaches representing impacted and unimpacted conditions. Baseline sampling sites should be included in the monitoring plan sites. Population densities of each fish species captured through electrofishing would be estimated, where adequate sample sizes permit, using the Seber-LeCren multiple pass method or comparable method to make population estimates.

Bioaccumulation of Metals in Fish Tissue

Fish would be collected from mainstem Rock Creek and the East and West forks of Rock Creek for metals analysis. Tissue samples from collected fish would be analyzed to determine concentrations of zinc, copper, and mercury and compared to baseline levels. Test procedures and analysis would be the same as those used for baseline testing, unless changed by the Agencies. Sampling would be done annually for 5 years and then every 3 years until reclamation was complete, unless otherwise required by the Agencies.

Spills and Accidents

In the event of an accidental discharge of toxic or hazardous materials or sediments, supplemental monitoring maybe required by the Agencies if there is a reasonable possibility that the environment could be adversely affected. ASARCO would be required to immediately report all such accidental discharges to permitting Agencies. The type, frequency, and location of monitoring would be contingent on the circumstances of the accident. Mitigations and recommended monitoring for several likely spill or accident scenarios would be developed as part of an Emergency Action Plan prior to mine operation. This would facilitate the process should a spill or accidental discharge of toxic or hazardous material occur.

Quality Assurance/Quality Control

To provide QA/QC for these studies, ASARCO would maintain a permanent taxonomic reference collection that contained all benthic species and representative samples of all dominant and indicator taxa of periphyton[4] collected from project area streams. Taxa identification in this collection must be documented and confirmed by taxonomic experts who must be selected in concurrence with the Agencies. This reference collection would be maintained by ASARCO through the period of postoperational monitoring. Following this period, the collection should be transferred to a depository selected by the Agencies for permanent scientific reference.

Reporting

ASARCO would submit an annual aquatic monitoring report that contained summaries of all aquatic monitoring data collected during the previous year. Each report must also discuss trends in plant and animal population patterns and evaluate changes in terrestrial and aquatic habitat quality, based on all data collected to date for the project. Recommendations in these reports could include modification to increase monitoring efficiency or to improve the quality of the data.

[4]All non-diatom taxa would be preserved in vials and representative permanent slide mounts made for diatom taxa.

The purpose of the baseline program is to sufficiently describe the aquatic community that existed prior to mine development and compare the baseline data to construction and operations data. Without an adequate baseline, it is difficult to determine whether changes in an aquatic community are caused by mine disturbances or by natural occurrences (i.e., seasons). The aquatics baseline data collected within the ASARCO Rock Creek project area from 1985-1988 appears to be inadequate for the following reasons:

- reference sites would not be comparable to potential impact sites;
- seasonal data for some sites are incomplete;
- some baseline sites were not sampled consistently because of flow problems;
- the alternative mill site location at the confluence of the East and West forks of Rock Creek could require selection of additional sites (for Alternative IV or V); and
- additional surveys are needed to better understand bull trout populations and the amount and condition of spawning habitat.

Prior to the beginning of the proposed project, an updated baseline monitoring program would be developed and implemented with approval by the Agencies.

RECLAMATION MONITORING PLAN

This plan provides the conceptual framework necessary for development of a reclamation monitoring program for the ASARCO Rock Creek Project. ASARCO had included a revegetation and a soils and erosion control monitoring plan in its application, however, the Agencies believe that those plans needed to be expanded to reduce the risk of sedimentation and revegetation failure (see Chapter 2 and **Appendix G**).

The final plan would contain specific information on soil salvage and handling, sampling methods, frequency of sampling, chemical parameters and analysis methods for any soil testing, and reporting. The reclamation monitoring program would begin as soon as construction activities were initiated and would continue until the Agencies released the reclamation bond.

The overall reclamation goal is to achieve short- and long-term stability and utility of the disturbed lands. The conceptual reclamation monitoring plan contains several elements:

- monitoring soil salvage, handling and quality;
- soil erosion and construction monitoring; and
- revegetation monitoring.

Monitoring of Soil Salvage and Handling

Monitoring would take place throughout mine life during soil salvaging and replacement to ensure that adequate reclamation materials were salvaged, stored and respread according to a revised and expanded soil salvage and handling plan. Soil depths would be verified using standard USDA methods.

Soil salvage activities would be monitored to verify depth and suitability (primarily rock content) of each lift. Monitoring would also verify that each lift was stored in appropriate locations. Soil replacement activities would be monitored to verify that lifts were replaced in the proper sequence and with sufficient depths. A 100 x 100-foot grid would be established on reshaped landforms at final reclamation of disturbances. After soil replacement, the grid would be resurveyed to verify proper total soil replacement

depths. The average of all sample points per reclaimed unit must meet the soil replacement depth identified for each disturbance area. In addition, no sample point on the grid should have less than 50 percent of the required replacement depth.

Stored soil would be tested before respreading to identify what, if any deficiencies or limitations in soil physical and chemical properties existed that may affect plant growth. Appropriate fertilizer, liming, organic matter, and other amendments would be determined.

Soil Erosion and Construction Monitoring

This component of the reclamation monitoring plan has two phases: monitoring of active construction and long-term maintenance monitoring. In general, monitoring would be done to identify areas where slumps, rills, gullies, and sheet wash were occurring. Any erosion problems identified would be immediately corrected.

ASARCO would conduct annual audits of best management practices (BMPs) implemented during construction of roads and other project facilities. This monitoring would be ongoing throughout road and mine construction and into the operational period for the tailings impoundment area. If deviations from BMPs were found, ASARCO would immediately correct the practice as well as resource damage that had occurred. In addition, sediment source surveys would be conducted in the Rock Creek and Bull River drainages. ASARCO would be responsible for mitigating sediment sources on NFS lands equivalent to 130 acres of disturbed land.

Routine long-term maintenance monitoring would be conducted during spring and fall and after heavy storm events. This monitoring would focus on reclaimed and disturbed areas. If necessary, immediate erosion control measures would be applied such as reseeding, mulching and other appropriate BMPs.

Revegetation Monitoring

Revegetation would be monitored annually during the growing season to identify areas where vegetation was failing and determine the cause. Revegetation monitoring should be conducted in conjunction with the routine soil maintenance monitoring. Systematic visual inspections would be conducted to identify areas that have inadequate cover, poor seedling growth, damage, or poor nutrition.

If problem areas were identified, ASARCO would need to identify the cause. If the cause appeared to be related to soil infertility or toxicity, then a soil testing program would need to be implemented for the problem area. Soil chemistry tests would be conducted to ascertain macro- and micronutrient status, pH, cation exchange capacity, and potential toxicity and heavy metal problems. Problems could also be caused by inadequate watering or inappropriate species or varieties being planted. Appropriate remedial actions would be taken to correct the problem.

Revegetation success of tree seedlings would be critical to mitigate the visual impacts of project facilities. A sampling design for monitoring tree stocking would be specified in the plan and approved by the Agencies. Other parameters such as ground cover, production or biomass, and plant density could be proposed by ASARCO to quantitatively evaluate the revegetation success of grasses, shrubs and forbs. Tree establishment surveys are recommended at years 1, 3, and 5 after planting.

Post-closure monitoring of trees should be conducted for up to 20 years after mining to determine if visual mitigations have been achieved. Frequency and amount of monitoring would be approved by the Agencies.

Reporting

An annual report would describe any reclamation problems that were identified and remedial measures taken.

APPENDIX J

REVISED PRELIMINARY DETERMINATION AIR QUALITY PERMIT

APPENDIX K

NEW MANAGEMENT AREA DESCRIPTIONS

I. MANAGEMENT AREA 23 - Electric Transmission Corridor

A. DESCRIPTION

This MA is composed entirely of the existing electric transmission corridor on the south end of the Forest which crosses along the south boundary of the Cabinet Mountains Wilderness. There is a low-standard access road providing repair and inspection access for the entire length. Vegetation varies from shrubs to small conifers. Almost all acres are in grizzly bear situation 1 and 2.

B. GOALS

Provide for the transmission of electricity in a safe and efficient manner. Protect the adjacent wilderness character, contribute to the diversity of surrounding wildlife habitat, and provide as much security as possible for the grizzly bear.

C. STANDARDS

1. These standards will also apply to any future corridors which may be located and approved.
2. The Forest-wide management direction included in Chapter II of this plan applies to this MA.

Recreation

1. The VQO is maximum modification.
2. The ROS class is predominantly rural.
3. Over-snow vehicles are allowed when conflicts with big game can be avoided.

Wildlife and Fish

1. Vegetation control will be coordinated with wildlife use to provide forage for winter range at lower elevations.
2. Security for wildlife will be provided by regulating access along the corridor. Regulation may include seasonal closures to all motorized vehicles but powerline maintenance personnel.
3. Any activity in this MA will be required to leave no trash or other grizzly attractant. Standards and guidelines specified in Appendix 8 (Grizzly Management situation Guidelines) will be applied for all activities on grizzly habitat.
4. Controls will be determined site specifically, but any herbicide used may not enter any water course.

Range

Grazing domestic livestock is permitted on the portions where grazing is also permitted on the adjacent MA.

Timber

1. This MA is not suitable for timber production.
2. Culture and harvest of Christmas trees or other products which can safely be grown and harvested under the powerline is permitted.
3. Harvest units in adjacent MAs should be planned to add visual diversity to the corridor edges.

Soil, Water and Air

1. Soil and Water Conservation Practices will guide the implementation and mitigation of all land disturbing activities.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana State Airshed Group.
3. Public motorized access may be restricted because of the need to control erosion on steep grades.

Mineral and Geology

1. Refer to Forest Standards for locatable minerals. Seasonal restrictions may occur.
2. Seasonal restrictions may be required for oil and gas leases and geophysical activities.
3. Generally, disposal of common minerals will not be permitted.

Facilities

1. The powerline access roads will be open to maintenance crews at all times.
2. Public access may be restricted based on the access restrictions of adjacent MAs.
3. Open roads will be maintained at level 2 or better.
4. Because of some steep grades on access roads, erosion control measures including structures, drainage dips, etc. will be inspected annually and constructed or maintained to prevent soil loss.

Fire

Prescribed Fire

Planned Ignitions--Planned ignitions for disposal of activity fuels or wildlife habitat enhancement are permitted.

Unplanned Ignitions Unplanned ignitions as prescribed fire are not permitted.

Wildfire

All seasons --All wildfires will be controlled.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade
None planned
Projected - Second Decade
None projected

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation A-3, A-5, A-7
Range D-1, D-2
Human & Comm Dev. H-3, H-4
Facilities L-1, L-2

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

II. MANAGEMENT AREA 31- Mineral Development

A. DESCRIPTION

This MA consists of permitted land areas that are directly involved with mineral production facilities such as major mine portals, mineral ore processing facilities, mineral tailings impoundments, water diversion structures, percolation areas, pipelines, and long-term equipment occupancy areas. They can be located within or adjacent to other MAs, depending on the final approved location of the mine and the necessary supporting facilities.

B. GOALS

Provide for the safe and healthful working areas for mineral production workers that are in concert with the surrounding MAs as much as possible. Additional sites for this MA will be provided as demand and successful mineral discoveries permit.

C. STANDARDS

1. These standards will apply to all mineral development areas.
2. The Forest-wide management direction included in Chapter II of this plan applies to this MA.
3. Due to the nature of the activity, VQOs do not apply during life of the Project. The long-term VQO to be applied after reclamation is Partial Retention.

<u>Recreation</u>

1. ROS does not apply during life of the Project. The long-term ROS class to be applied after reclamation is Roaded Natural.
2. ORV use is not permitted in this MA.

<u>Wildlife and Fish</u>

1. Locate facilities, if possible, away from important winter range, calving areas, riparian areas and meadows.
2. Activities will be scheduled, if possible, to prevent conflict with wildlife use in adjacent MAs, particularly winter range use.
3. Activities will be conducted to prevent siltation in streams that provide spawning habitat for both resident and migratory fish.

<u>Range</u>

Domestic livestock grazing is generally not permitted.

Timber

1. This MA is not suitable for timber production.
2. Salvage harvest may occur to remove trees infested by insects or disease, to remove hazard trees, or for other land clearing necessary for mineral production purposes.
3. Landing areas for timber harvest on adjacent MAs are permitted if there is no conflict with the mineral production facility, soil protection, water quality, or cultural site protection.

Soil, Water and Air

1. Soil and Water Conservation Practices will be followed for any activity.
2. Comply with the Smoke Management Plan published by the Air Quality Bureau of the Montana Department of Health and Environmental Sciences and administered by the Montana State Airshed Group.

Riparian (See Riparian Area, Chapter III)

Mineral and Geology

1. Refer to Forest Standards for locatable minerals. Seasonal restrictions may occur.
2. Stipulate no surface occupancy for oil and gas leases.
3. Removal of common minerals will generally not be permitted unless it is consistent with the mineral production facility needs.

Lands

Special uses, rights-of way, easements, or cost-share agreements may be authorized on a case-by case basis, provided that they are consistent with the mineral production facility.

Facilities

1. Permanent roads are anticipated and will be maintained for safe use.
2. Temporary roads will be closed, drained, and revegetated.

D. SCHEDULE OF MANAGEMENT PRACTICES

Planned - First Decade
None planned
Projected - Second Decade
None projected

E. MONITORING AND EVALUATION REQUIREMENTS

The specific monitoring requirements from Chapter IV that are applicable to this MA are:

Recreation	A-7
Range	C-9
Soil and Water	F-1
Minerals	G-1

The procedures outlined in Chapter IV will be followed to evaluate the data gathered during monitoring.

APPENDIX M

TENTATIVE MPDES PERMIT FACT SHEET AND STATEMENT OF BASIS

APPENDIX L

FAILURE MODES EFFECTS ANALYSIS

FAILURE MODES EFFECTS ANALYSIS

BACKGROUND

The Agencies, after considering comments on the draft EIS and in consideration of additional tailings handling data offered by ASARCO, contracted for a third party review and Failure Modes Effects Analysis, or FMEA, to review tailings paste technologies and acid rock drainage potential. The FMEA is an engineering reliability technique used to systematically identify, characterize, and screen risks that derive from the failure of an engineered system to operate or perform as intended. Originally developed for use in nuclear safety, FMEA has been widely applied, for example, in the chemical industry since the Bhopal, India, disaster and by NASA since the space shuttle Challenger accident. Although FMEA does not by itself reduce risks, the systematic risk characterization provides an effective method for designing risk management and mitigation strategies that do. For the Rock Creek Project, FMEA provides for improved understanding and characterization of mining-related risk associated with paste tailings placement (Alternative V) and acid rock drainage (ARD). For more detailed information, copies of the Rock Creek Project FMEA are available from the Kootenai National Forest and Montana DEQ.

Fundamental to FMEA is the meaning of "risk" defined by Webster's Dictionary as "the possibility of loss". This concept of risk embodies two components: an uncertain state of knowledge about the occurrence of an event and adverse effects produced by the event should it occur. Expressed more simply:

Risk = (likelihood) x (consequences)

To characterize risk, both the relative likelihood of a failure event and its consequences must be considered. As a qualitative technique, likelihood and consequences are evaluated in FMEA using professional judgment and opinion. This is accomplished in a workshop format including not just technical experts, but also those more knowledgeable about baseline data and operation and maintenance of the actual system. The opportunity for interchange and interaction among the workshop participants, using risk as the common denominator, can be among the most important benefits that FMEA provides. For any complex system, risks derived from many sources. Failure of any one component can directly affect other components or the overall system. FMEA evaluates the failure likelihood and consequences for each individual component, allowing those with highest risk to be identified for further analysis or targeted for risk reduction measures. Only recently have FMEA techniques originally developed for electrical and mechanical systems been adapted to the environmental effects of mining (e.g. Ferguson and Roberston, 1994; Dushnisky and Vick, 1996), but these applications are not conceptually complex. They simply treat the structures and facilities of the mine as system components, and view the consequences of the component failure in terms of environmental damage. In this way, these environmental applications of FMEA may achieved the following purposes:

- to systematically identify and catalog those mine structures and facilities whose failure to operate or perform as intended would pose risk to the environment;
- to identify those mine features and potential occurrences that are the dominant risk contributors, as distinct from others that produce comparatively lesser risk; and
- to develop a sense of the overall reliability of the environmental protection features incorporated in mine planning, design, and operations.

At the same time, these FMEA applications function within the context of several assumptions and limitations including the following.

- FMEA does not serve as a quality assurance device, and it assumes that the facilities have been constructed as designed.
- FMEA is different from regulatory compliance or environmental audits and it does not fulfill their specific purposes.
- FMEA seeks to characterize risks in a systematic way and is intended to identify the main risks or failure modes. FMEA reflects the information, judgment, and professional opinion available and expressed in the workshop(s) at the time it was performed. Just as these factors may change over time, so too can the assessment of risk be expected to vary according to additional information or the evaluation of others.

FMEA FRAMEWORK

FMEA characteristically includes several steps performed in logical sequence. These are described below for the Rock Creek Project FMEA.

System Description

The project is typically subdivided into a number of key components which group together related facilities and provide a focus for "what can go wrong" with that component. Key components that were considered for the Rock Creek Project include Bottom-Up Paste Tailings Facility, Top-Down Paste Tailings Facility, and Mine Workings and Waste Rock.

Each of the main components were then further subdivided into sub-components, and failure modes identified for various aspects of each component. The failure modes also consider the development phases which included: construction, operation, decommissioning, and post closure land use.

Likelihood Categories

Although failure likelihoods are intended to be qualitative, broad numerical probability ranges are useful in promoting consistency among workshop participants in verbally expressed judgements. The categories are:

- Negligible - equivalent to a return period of more than 1 million years. Risk could be similar to the risk of being injured in an elevator ride;
- Very Low - a return period of 10,000 and 1 million years. This is the current range for the likelihood of failure of U.S. water dams and similar to the likelihood of being struck by lightning;
- Low - a return period of 100 and 10,000 year. This is the range associated with likelihood of death from cancer, mountaineering and suicide;
- Moderate - a return period of between 10 and 100 years. This is the range associated with likelihood of failure of mine pit slopes, and marine shipping accidents; and
- High - a return period of less than 10 years. Something that happens regularly.

Likelihood categories defined are generally understood to be on an annual basis, and thus must be accumulated over the relevant exposure period. For example, failure modes with a high likelihood are very likely to happen at least once over the operating life of the mine and failure modes with a low likelihood are very likely to happen at least once over the 1,000 year post closure analysis period.

Some risks are not cumulative with time and these include the potential for acid rock drainage in which the likelihood is determined by the actual geology, hydrogeology, and geochemistry.

Consequences

The consequence of any component failure is described as a mutually exclusive consequence set. For the Rock Creek Project, two categories of consequences were selected and these include:

water quality and socio-economic consequences. Impact categories are negligible, low, moderate, high, and extreme.

Confidence Categories

Judgment on likelihood and consequences made by workshop participants may vary substantially in their associated degrees of confidence depending on the technical information available and how well that process or effect is understood. Confidence categories that apply to both the likelihood and the consequence categories are:

- Low - do not have confidence in the estimate, or could vary significantly;
- Moderate - have some confidence in the estimate, or moderate variability; and
- High - confident, or low variability

Binning

The workshop and FMEA tabulation provides the basic information for evaluating failure modes and developing risk management plans. The first step in this process is termed "binning" where likelihoods are paired with consequences to screen out the higher risk failure modes. The high likelihoods coupled with high consequences, for example, would "bin out" as a high risk. The binning of risk also considers the confidence category, for example a low confidence category could mean that the likelihood or consequence could increase and move it into a higher risk category. The time exposure period affects the binning for the post closure land use phase, and for this case all risks with a low likelihood were binned out.

Compensating Factors

During the FMEA process each risk item was assessed with respect to what compensating factors could reduce the risk. Compensating factors, for example, could include design changes or more detailed studies. These compensating factors would typically then be included in the risk management plan for the project. The risks after compensating factors are applied are then reassessed with compensating factors implemented.

Risk Management Plan

On the basis of the binning process and compensating factors, a risk management plan is developed for the high risk items. The risk management plan forms the basis for developing mitigations to the proposed operating plan. Included in this can be changes in designs, further investigative studies, monitoring requirements, quality assurance/quality control processes, or any other modification which would reduce the risk associated with a particular design feature.

APPENDIX N

ASARCO's WETLANDS MITIGATION PLAN FOR ALTERNATIVE V

This appendix contains a copy of ASARCO's preliminary designs for wetlands mitigation associated with the Alternative V tailings paste deposition. The wetland mitigation designs presented in this appendix have been prepared by ASARCO (the Applicant) and have not been modified or changed by the Agencies. This appendix is provided, along with the Preliminary Section 404 (b)(1) Showing (Appendix C), to solicit public input, comments, and foster increased public awareness and participation in the Environmental Impact Statement (EIS) process.

Agencies' note: This Plan is the third Chapter of ASARCO's Revised Rock Creek Wetland Inventory (Chapter 1); Consideration of Alternatives (Chapter 2); and Wetland Mitigation Plan (Chapter 3). Chapters 1 and 2 are presented in ASARCO's 1995 Revision (ASARCO Incorporated 1995). This copy of Chapter 3 was revised in 1997 based on changes associated with Alternative V.

3.0 WETLAND MITIGATION PLAN

The Rock Creek Project, at the end of operations, will directly affect approximately 4.84 acres of jurisdictional wetland and potentially indirectly affect about 1.18 acres of adjacent jurisdictional wetland. The project will also directly affect about 0.36 acres of non-wetland Waters of the U.S. The goal of the mitigation plan is to provide "no net loss" of wetland. Table 3-1 summarizes acreage of wetland and non-wetland Waters to be affected and acreage to be created by mitigation. Table 2-3 in Section 2.3 details, by project component, the amount of directly and indirectly affected wetland and non-wetland Waters of the U.S. In compliance with Section 404(b)(1) of the Clean Water Act, the mitigation plan provides appropriate mitigation and compensation of the unavoidable loss and potential diminishment of wetland values associated with development of the Rock Creek Project. Appendix C of the September 1995 DEIS prepared by the agencies is a Preliminary Section 404(b)(1) Showing that provides additional detail concerning compliance with the guidelines. The 404(b)(1) Showing will be updated as necessary in a Supplemental DEIS addressing proposed project modifications. About 7.0 acres of wetlands will be created to compensate for the loss of 6.38 acres of directly and indirectly affected Waters of the U.S.

3.1 SELECTION OF WETLAND MITIGATION SITES

Mitigation by avoidance and minimization of impacts to Waters of the U.S. is discussed in Section 2.3. Wetland creation is proposed to mitigate unavoidable wetland losses. Wetland creation will be conducted at three sites identified as:

1) Miller Gulch Tributary: This site is an ephemeral-flow drainage west of the proposed tailing storage site (Asarco and USFS surface ownership);

TABLE 3-1. SUMMARY OF WATERS OF THE U.S. AFFECTED AND CREATED, ROCK CREEK PROJECT, SANDERS COUNTY, MONTANA.

CATEGORY	ACREAGE AFFECTED[1]		ACREAGE CREATED[2]
	Direct	Indirect	
Wetland	4.84	1.18	7.0
Non-Wetland Waters	0.36	0.0	0.0
TOTALS	5.20	1.18	7.0

[1]See Table 2-3 in Section 2.3
[2]See Table 3-2.

2) Upper Rock Creek: This site is between Rock Creek and FS Road 150 north of the proposed tailing storage site and south of the proposed mill site (Asarco surface ownership);

3) Lower Rock Creek: This site is east of the proposed tailing storage site and north of Rock Creek in the vicinity of the previously proposed Borrow Area 3 (USFS surface ownership). Borrow Area 3 was deleted as a result of design changes in the tailing storage facility.

Wetland creation (mitigation) sites are shown on Figure 3-1 and discussed in subsequent sections. Figure 3-1 also depicts three (3) sites for additional wetland creation should proposed sites prove unfeasible or should projected wetland creation acreage fail to meet proposed goals at any mitigation site. Acres of proposed wetland creation are listed by site in Table 3-2.

As final design is completed for the Rock Creek Project, some mine-related components such as borrow areas for reclamation material, diversion ditches, or other storm water control structures may be found suitable for wetland mitigation. If proposed mitigation is not successful, these additional alternative sites will be evaluated in conjunction with involved agencies for suitability for wetland creation.

FIGURE 3-1

TABLE 3-2. ACRES OF PROPOSED WETLAND CREATION BY SITE, ROCK CREEK PROJECT, SANDERS COUNTY, MONTANA

SITE NAME	SITE NUMBER	AREA (Acres)
Miller Gulch Tributary	1	0.06
	2	0.07
	3	0.10
	4	0.23
	5	0.15
	6	0.11
	7	0.31
	8	0.12
SUBTOTAL		**1.15**
Upper Rock Creek		4.42
Lower Rock Creek		1.43
TOTAL WETLAND CREATION		**7.00**

Criteria used for mitigation site selection included: 1) suitability for establishing similar functions and values as directly and indirectly affected wetland; 2) proximity to the project area yet sufficiently removed from activity to reduce project-related disturbance; 3) surface ownership; 4) cumulative acreage of sites to achieve a minimum acreage replacement ratio of one-for-one; and 5) relative cost of mitigation.

In general, there are two broad classes of wetlands based on hydrology: 1) wetlands which derive water from perennially shallow or seasonally shallow water tables and 2) wetlands which derive water from surface water run-on and/or precipitation. The mitigation site for groundwater supplied wetlands (Upper Rock Creek wetland mitigation site) was selected based on groundwater level observations for a well in the area and demonstration test sites. Suitability of the mitigation sites for surface water supplied wetlands (Miller Gulch Tributary and Lower Rock Creek) was based on a detailed water balance. Specific climatic and hydrologic factors evaluated in the design of surface water supplied mitigation wetland areas included:

- average monthly precipitation and evaporation
- average monthly runoff
- infiltration into soils
- retention period of inundation

These factors were used to determine the average monthly volume of water stored in each wetland and, based on the configuration (shape and depth) of the wetlands, the areal extent of saturated/inundated soils for each wetland are estimated. Methods of calculation, and summary water balances for the proposed Miller Gulch Tributary and Lower Rock Creek mitigation wetland sites are presented in Appendices 3-1 and 3-2. As designed, these mitigation wetlands would be fully inundated for three to four months during snowmelt runoff (March through May or June) and partially inundated or saturated through July and August.

3.2 WETLAND MITIGATION DESIGN

Criteria used in developing wetland mitigation included:

- Avoid disturbance to existing wetland;

- Select areas where wetland can be created with similar functions and values as those directly and indirectly affected by the operation;

- Select sites as close to disturbed wetland as possible;

- Select sites that have the hydrologic, edaphic and topographic capability to support and maintain wetland;

- Select areas where surface ownership favors long-term management of wetland;

- Develop mitigation plans that do not rely on periodic maintenance; and

- Minimize potential impacts of constructed wetland on adjacent or downstream land or to sensitive plant or animal species.

3.2.1 Miller Gulch Tributary

The main tributary of Miller Gulch (M-3) drains the northwestern portion of the proposed tailing storage facility. A narrow linear wetland in the upper portion of this drainage will be filled by construction of the tailing storage facility. A side drainage of this tributary in sections 21 and 28 (Figure 3-2) does not currently contain wetlands and will not be filled by the operation. This side drainage will be used to create wetlands with functions and values similar to small, seasonally inundated or saturated wetlands affected by the tailing storage facility. Surface ownership of this mitigation site is Asarco and USFS.

Establishment of Wetland Hydrology

Establishment of wetland hydrology in the side drainage will rely on duplication of hydrologic conditions which have resulted in existing wetland formation within the proposed tailing storage area. These hydrologic conditions are seasonal concentration and/or temporary retention of water on low permeability, poorly-drained lacustrine soils. Concentration or storage of water on these fine-grained lacustrine sediments results in saturated and occasionally inundated soils for a duration and frequency which allows the development of wetland vegetation communities.
Surficial materials in the side drainage are low permeability lacustrine deposits of silty clay and sandy silt which also underlie the existing Miller Gulch wetlands immediately to the north (Sheet 1, Exhibit 1). Although the area of the side drainage basin is not large (36.3 acres) and will be reduced by about 6.4 acres by the tailing impoundment, the drainage basin is similar in size to

FIGURE 3-2

other nearby drainages that do support wetland areas. The primary reason that the drainage does not currently contain wetlands is that the drainage has a steeper gradient than other adjacent drainages supporting wetlands. As a result of this steeper gradient, retention of surface runoff and saturation/inundation of soils is of insufficient duration to support hydrophytic vegetation communities.

Establishment of wetland hydrology in the side drainage will rely on flow barriers designed to increase surface runoff retention and duration of soil saturation/inundation. Methods of calculation, and summary water balances for this mitigation site are in Appendix 3-1. As designed, these mitigation wetlands would be fully inundated for three to four months during snowmelt runoff (March through May or June) and partially inundated or saturated through July and August.

Site Development

During wetland identification and delineation surveys, it was observed that minor depressions created by past logging disturbance in drainages and downed logs across drainage bottoms provided sufficient increased moisture retention to support localized hydrophytic vegetation. Creation of flow barriers in the tributary to Miller Gulch will increase water retention and allow hydrophytic vegetation development. Small detention dikes will be constructed at approximately 200-foot intervals along the length of the drainage (Figure 3-2). The dikes will be 30 to 50 feet long with a maximum height of five feet (Figure 3-3). The detention dikes will retain flows for sufficient time during seasonal precipitation events (and snowmelt) to allow establishment of hydrophytic vegetation. Rock-lined spillways will be designed for each dike.

Prior to dike construction, soils and substrate in the drainage will be evaluated to assess permeability. If hydraulic conductivity is greater than 10^{-6} or 10^{-7} cm/s, sealing or lining of the areas upstream of the dikes will be considered.

Figure 3-3

At some moisture retention sites, minor grading will be conducted to extend areal extent of the seasonally flooded area.

Soil Handling

Soils on this mitigation site have formed in silt loam to silty clay loam lacustrine sediments exhibiting good salvage quality to 11 inches. A portion of the soils in each retention area will be used for detention dike construction, and will provide suitable materials for dike revegetation and stabilization.

Hydric soils from the portion of Miller Gulch to be affected by the tailing storage facility will be salvaged and directly respread on the mitigation sites providing increased organic matter and a plant materials source.

Hydrophytic Vegetation Establishment

The hydrophytic vegetation community in the portion of Miller Gulch to be affected is a forested wetland dominated by western red cedar (*Thuja plicata*) and black cottonwood (*Populus trichocarpa*). Common understory species include alder (*Alnus* spp.), red-osier dogwood (*Cornus stolonifera*), bunchberry dogwood (*Cornus canadensis*), wild sarsaparilla (*Aralia nudicaulis*) and western goldthread (*Coptis occidentalis*).

The mitigation site will be revegetated to a forested wetland using the mixture in Table 3-3. The following approach will be used for revegetation:

- Non-hydrophytic trees (all species except western red cedar and black cottonwood) will be salvaged prior to mitigation. Slash and stumps will be dozer-piled and burned.

TABLE 3-3

- Following detention dike construction, available hydric soils salvaged from the tailing storage facility site will be spread along the drainage.

- After seedbed preparation (discing or harrowing), the area will be broadcast seeded with the Forested Wetland Mixture (Table 3-3). Trees and shrubs listed in Table 3-3 will be planted in any areas where western red cedar or black cottonwood are absent. Containerized stock and rooted cuttings will be planted using materials collected in the vicinity of the project area. All stock will be dormant and in good condition when planted. Hand tools or mechanized equipment will be used to plant stock; proper planting procedures will be observed to maximize seedling survival. Planting densities are given in Table 3-3.

- Noxious weed-free straw mulch (2,000 pounds/acre) will be evenly spread and crimped or the sites will be hydromulched (cellulose fiber mulch at 1,500 pounds/acre with tackifier at manufacturer's recommended rate).

Re-establishment of Functions and Values

The wetlands proposed to be directly or indirectly affected in the upper portions of Miller Gulch Tributary M3, and nearby wetland areas not within this drainage, are located in intermittent drainages associated with gentle rolling topography, and have formed in natural low gradient drainages and surface depressions that concentrate surface water run-on from adjacent areas. Some of these wetland areas have formed in surface depressions caused by previous land disturbances (logging and skid trails). These wetlands are dependent on surface water run-on and/or precipitation, and are not dependent on perennially or seasonally shallow water tables. The low permeability of the near surface clays and silts, and the low hydraulic gradients in the area have created saturated soils and seasonal shallow standing water. For the purposes of wetland classification, many of these areas are considered to be Emergent Palustrine Wetlands.

The primary objective associated with the creation of the Miller Gulch Tributary wetland mitigation sites is to establish long-term wetland functions and values comparable to or greater than the wetland functions and values of the nearby directly or indirectly affected Miller Gulch area wetlands, as well as similar nearby affected wetlands not within the M3 Miller Gulch Tributary drainage. This objective includes the establishment of these functions and values in a manner that will not adversely affect the functions and values of other downgradient undisturbed wetlands.

Primary functions and values associated with the wetlands proposed to be directly and indirectly affected include sediment retention and aquatic and wildlife diversity/abundance. Additional discussion of the consideration of other functions and values for the affected wetlands is in Section 1.4.

Sediment Retention: The low flow gradient and seasonal, shallow standing water characterizing many of these wetlands provide for the retention of sediments contributed by surface run-on from adjacent upgradient areas. These wetland areas, because of their generally small size and discontinuous pattern, are considered to have a moderate site-specific sediment retention function and value, and limited regional importance.

The several small wetland basins proposed to be established within the Miller Gulch Tributary wetland mitigation site will function to retain sediments associated with captured seasonal surface run-on from upgradient areas. The created basins will achieve this function immediately following construction (preproduction year 3), although the effectiveness of this function will likely be somewhat reduced until the proposed wetland vegetation has become established. Following the establishment of the wetland vegetation, the small wetland basins will provide a long-term function and value for sediment retention comparable to the directly and indirectly affected wetlands. The sediment load associated with the upgradient seasonal run-on is not heavy, and the created wetlands are anticipated to be functional for sediment retention for many years following the completion of the mining project.

The sediment retention functionality of the wetland basins will be visually monitored routinely during the life of the mining project. Should the monitoring indicate that sediment retention is adversely affecting site life expectancy, or other re-established functions and values of the wetlands, corrective measures will be developed in consultation with the COE, and other appropriate agencies. These measures could include the creation of additional wetlands in alternative locations.

Aquatic and Wildlife Diversify/Abundance: The wetlands proposed to be directly and indirectly affected provide seasonal habitat for a variety of wildlife species, including amphibians, as well as aquatic macroinvertebrates. These affected wetlands do not provide fish habitat. None of the wildlife habitat provided by these wetlands is rare or critical to the survival of any wildlife species. Because the affected wetlands are small in size, and wetlands providing similar habitat are common in the Rock Creek drainage area and adjacent regions, they are considered to have low to moderate site specific aquatic and wildlife diversity/abundance functions and values.

The small forested wetland basins proposed to be created within the Miller Gulch Tributary wetland mitigation site will provide aquatic and wildlife habitat functions and values comparable to the forested wetlands proposed to be directly or indirectly affected. These functions and values, however, will not be fully established until the successful establishment of forest wetland vegetation within each wetland basin (preproduction year 22). Prompt establishment of herbaceous wetland vegetation will be aided by direct application, during construction, of wetland soils salvaged from directly affected wetlands.

Because the upper-most portions of the proposed mitigation site are located near the toe of the tailing disposal area, human activity and equipment operation associated with tailing disposal activities can be expected to initially reduce the re-established wildlife functions and values of this portion of the site. This impact will be significantly reduced upon completion and successful reclamation of that portion of the tailing disposal area located upgradient (about production year 22). It is anticipated, however, that wildlife may habituate to the nearby human and equipment

activity, and comparable wildlife use of the upper-most wetland basin sites could occur much earlier.

The tailing disposal area will occupy approximately 6.4 acres of the 36.3 acre drainage basin of the mitigation sites. During active tailing disposal, storm water runoff capture associated with the surface water management plan for upgradient areas affected by tailing disposal will route storm water runoff to detention ponds located in upland areas outside the mitigation site drainage. The water balance prepared for the Miller Gulch Tributary mitigation site has considered this loss of seasonal runoff contribution. This loss will not adversely affect the ability of the created wetlands to re-establish wildlife-related functions and values.

As discussed previously, the created wetlands in the Miller Gulch Tributary mitigation site are anticipated to provide beneficial wetland functions and values throughout the life of the mine project, and for many years thereafter. Monitoring of this functionally will occur routinely throughout the mine project life, with the development of corrective measures if problems are noted.

3.2.2 Upper Rock Creek (Section 22)

This mitigation site, located in the E1/2 E1/2 of Section 22, T26N, R32W (Figure 3-1), consists of a broad, gently sloping bench between Rock Creek and the proposed utility corridor. The site is owned by Asarco. Mitigation will create linear wetlands adjacent to Rock Creek (Figure 3-4).

FIGURE 3-4

Establishment of Wetland Hydrology

Numerous riparian and/or wetland areas occur along Rock Creek on lower terraces or in stream channels either abandoned or occupied infrequently during high flow events. These areas derive their water from seasonally high water tables (i.e., groundwater at shallow depths) or from periodic overflow of Rock Creek. Higher terraces, benches and abandoned channels are elevated above the water table and do not support wetland hydrology or wetlands. Linear wetlands will be established in this non-wetland site by excavating to a depth which will allow saturation/inundation by shallow groundwater. Based on observation of a hand-dug domestic well (PW-6) located at the northern end of the mitigation area, groundwater level in this portion of the area is generally six feet or less below ground surface. Backhoe pits constructed in the area during November, 1996 encountered water-bearing gravels overlying clay at about 8 feet below ground surface.

In order to determine feasibility of the site to support wetlands, Demonstration Cells were constructed. Two Demonstration Cells were excavated on November 14, 1996 in depressional locations approximately 100 feet (Cell A) and 400 feet (Cell B) west of the Rock Creek drainage forest road (Figure 3-4). Excavation at both locations encountered water-bearing gravels on a clay pan at approximately eight feet below the general grade of the recently logged area. This clay pan was left intact, and the area of each cell was expanded to accommodate slope reduction. Piezometers were installed at both locations.

The total disturbance area of Demonstration Cell A is approximately 600 square feet, including approximately 50 square feet at the bottom that had filled with shallow standing water within a few hours. The total disturbance area of Demonstration Cell B is approximately 1200 square feet, including approximately 100 square feet at the bottom that also filled with shallow standing water within a few hours. These cells will be revisited in Spring 1997 to record water levels, sample for water chemistry/quality, and establish wetland vegetation.

Site Development

Proposed wetland channels shown on Figure 3-4 are conceptual. Actual locations will be determined in the field utilizing existing historical non-wetland channels and topographically lower areas.

Prior to excavation and following tree and shrub removal, topsoil will be salvaged from all areas to be disturbed and stockpiled in non-wetland areas adjacent to the site. Material will be excavated in a linear configuration using scrapers, dozers or backhoes depending on availability and site conditions. Excavation depth will depend on groundwater levels encountered during construction but is anticipated to be about 6 to 8 feet based on observed pre-construction groundwater levels.

Excavated material will be used for fill on the access road or other project components. If not needed for construction, fill will be mounded after topsoil has been salvaged between the created wetlands and Rock Creek (in non-wetland areas outside the riparian zone). The berm will be graded to blend with natural topography, topsoiled and revegetated.

The mitigation sites will be constructed with a slight (less than 1 percent) slope toward the south. Constructed channels will not be connected to Rock Creek to minimize potential scour from high flows.

Width of the bottom of the linear sites will vary from 10 to 25 feet. Uniform width will be avoided to create a more natural configuration. Small depressions will be constructed along the longitudinal profile of each linear site to increase water retention late in the season when groundwater levels may decline. Benches will be constructed on one or both sides of the bottom (Figure 3-5) to create zones with variable periods of saturation or inundation. The benches, at 6 to 12 inches above the bottom, will be saturated or inundated only during spring. The bottom

FIGURE 3-5

will remain saturated later into the growing season. The shallow depressions will be inundated or saturated for the majority of the growing season. Sideslopes of the mitigation sites will vary reflecting excavation depth and natural topography. In general, one side of the excavation will be constructed at a relatively steep slope (40 to 50 percent) with the opposite side constructed at a gentle to moderate slope (10 to 40 percent). Variable slopes will enhance topographic and resulting vegetative diversity.

Soil Handling

Soil salvaged from areas to be disturbed by wetland creation (channels, sideslopes and berm area) will be respread on all portions of the mitigation site (slopes, bottom, benches, depressions and berm). Soils in this area are formed in stream terrace sandy loam alluvium. These terrace soils exhibit good salvage quality to 13 inches. Respread soils will be disced or harrowed to provide a proper seedbed. Since soil storage would be of short duration, fertilization is not proposed.

Since wetland hydrology will be provided by groundwater, no amendments (such as silty lake sediments or clay) are proposed to decrease permeability of the constructed channel bottom.

Hydrophytic Vegetation Establishment

The linear mitigation sites will be revegetated using the herbaceous wetland revegetation mix (Table 3-4). The proximity of Rock Creek to the area will allow for natural reinvasion of additional hydrophytic species. Channel sideslopes and the berm will be seeded with the upland herbaceous mix presented in the Rock Creek Project Application for Operating Permit/Plan of Operations.

Table 3-4

Since the narrow configuration of the mitigation sites would preclude effective drill seeding, broadcast seeding (hand-held seeder or hydroseeder) will be used. The sites will be mulched with noxious weed-free straw (2000 pounds/acre) or cellulose fiber (hydromulch at 1500 pounds/acre).

Re-establishment of Functions and Values

The primary objective associated with wetland mitigation at the Upper Rock Creek site is to create wetland areas with long-term functions and values comparable to or greater than existing riparian/wetland areas located on lower terraces along Rock Creek or in stream channels either abandoned or occupied infrequently during high flow events. These existing wetlands are dependent on seasonally high water tables or from periodic overflow of Rock Creek, and are classified as Forested Palustrine Wetlands.

The primary function and value associated with riparian and/or wetland areas located on lower terraces along Rock Creek is wildlife diversity and abundance (see Section 1.4.9). With respect to wildlife, important wetland factors in the Rock Creek drainage are size and distribution; wetlands are common, are distributed throughout the study area, and are present in most larger blocks of wildlife habitat and/or habitat complexes, but individual wetlands are small. Thus occurrence and availability do not limit wildlife use of wetlands, but wetland size may be a limiting factor for some species or species groups.

Wildlife Diversity/Abundance: The existing riparian/wetland areas along the lower terraces of Rock Creek are the result of periodic overflow and the migration of the channel of Rock Creek, as well as overflow channels, in response to peak flow events. This has created a diversity of wildlife habitat in these areas adjacent to the main channel of Rock Creek, including cover and browse for larger species of wildlife (white-tailed deer, elk, moose and bears), habitat for lynx, fisher and other furbearers, and resting and foraging areas for several species of birds, including limited seasonal waterfowl and shorebird habitat. In addition, muskrat, beaver and river otter likely use these areas. These areas also provide habitat for herptiles and aquatic

macroinvertebrates. One Federally listed endangered or threatened species, the grizzly bear, may also use these riparian/wetland areas as a microsite habitat source of succulent forage.

The objective of the design of the Upper Rock Creek wetland mitigation site is to create new wetlands that will provide additional long-term beneficial wildlife diversity/abundance functions and values to the adjacent (as well as upstream/downstream) Rock Creek riparian/wetland areas. The design of a series of linear wetland areas excavated to varying depths will provide for saturation/inundation by shallow groundwater, and will recreate wetland conditions characterizing the adjacent riparian/wetland areas. This will allow for the successful establishment of wetland vegetation and wildlife diversity/abundance functions and values currently being provided by the existing riparian/wetland areas along Rock Creek.

The functionality of the created wetlands to provide additional beneficial wildlife diversity/abundance values will not be fully established until successful wetland revegetation has occurred, including maturation of seeded species and the natural re-invasion of additional adjacent hydrophytic species. It is anticipated, however, that this process will likely be rapid, as Demonstration Cells constructed at the site in the fall of 1996 showed that sufficient shallow groundwater is present to allow the immediate establishment of wetland hydrology. Seeding of the Demonstration Cell areas scheduled for spring 1997 will provide additional information to access the rapidity of the establishment of wetland vegetation and associated wildlife diversity/abundance functions and values.

The upper-most portions of the Upper Rock Creek wetland mitigation site are located near to (south of) the proposed support facility for the exploration adit phase of the Rock Creek Project. The nearness of human activity to the created wetland site may initially reduce wildlife use of this portion of the new wetland site. Human activity at these facilities during the exploration phase, however, will be light, and the facilities will be removed following completion of the exploration adit project (preproduction year 5). Following removal of the facilities, human activity in the vicinity of the new wetland site will be reduced. In addition, it should be noted that the DEIS

agencies are considering whether to include a relocation of the proposed exploration support facilities to the water treatment plant site at the lower end of the Rock Creek drainage as a component of Alternative V. If this relocation is selected by the agencies, construction of the support facility would not occur in the vicinity of the proposed Upper Rock Creek wetland mitigation site.

The eastern-most portions of the Upper Rock Creek wetland mitigation site would be located near to the main access road and utility corridor for the Rock Creek Project. This road would be used by the general public, as well as by project-related vehicles during the exploration and operational phase of the mine project. Use by project-related vehicles, however, will be significantly reduced by the incorporation of employee busing in Alternative V. Mine employees will be bused from an employee parking lot to be provided near the water treatment plant at the lower end of the Rock Creek drainage. The use of busing will significantly reduce the potential for vehicle-related disturbance to the newly created wetlands and their beneficial wildlife functions and values.

The proposed Upper Rock Creek wetland mitigation site will rely on the demonstrated availability of shallow groundwater to successfully achieve and maintain long-term wildlife functions and values. Once the wetland wildlife functions and values have been established through successful revegetation, the functional life of the wetlands is anticipated to extend well beyond the life of the mining project, and to be similar to the functional life of the adjacent riparian/wetland areas.

3.2.3 Lower Rock Creek

The Lower Rock Creek site, located in the W1/2 of Section 27, T26N, R32W (Figure 3-1), consists of a gently sloping toeslope and bench north of Rock Creek. The site entails a portion of the area previously designated as Borrow Area 3. Since Borrow Area 3 was initially proposed for excavation of material for starter dike construction and tentative design modifications have eliminated the need for originally proposed volumes of borrow material, proposed wetland of the

excavated borrow area near the elevation of Rock Creek, wetlands will be created by constructing linear channels in the existing topography (Figure 3-6). It is possible that some borrow may be necessary at this site for construction of the tailing storage facility. If so, wetlands would be created at the bottom of the borrow area and wetland mitigation design would be modified to account for any topographic changes.

Establishment of Wetland Hydrology

Without the previously proposed borrow area excavation, ground water levels are substantially below the elevation of proposed mitigation and would not provide wetland hydrology. Establishment of wetland hydrology at this site, therefore, will rely on seasonal concentration and/or temporary retention of water on low permeability substrates, similar to existing wetlands in the proposed tailing storage facility.

On-site investigations with representatives of COE and Asarco during fall, 1996 identified small sites in this vicinity where logging and road construction have created depressions that retain seasonal runoff resulting in creation of wetland hydrology. If necessary, flow barriers would be constructed at the proposed mitigation site to increase the period of inundation and saturation. Also, prior to construction, soil proposed for use in the channel bottom will be evaluated to assess permeability. If this evaluation concludes that soils would be too permeable to support wetland hydrology, the channel bottoms will be amended to provide conditions suitable for

FIGURE 3-6

formation of wetland hydrology. Silts or clays formed from glacial lake sediments in the tailing storage facility would be used as a low permeability amendment in the channel bottoms.

An annual water balance for the Lower Rock Creek site is presented in Appendix 3-2. Mitigation wetlands would have wetland hydrology throughout the growing season.

Site Development

Channel locations depicted on Figure 3-6 are conceptual. Actual locations will be selected in the field to take advantage of microtopography and to optimize surface water run-in.

Following tree removal, topsoil will be salvaged and stockpiled in non-wetland areas adjacent to the site. Subsoil material will be excavated to a depth of 2 to 3 feet and a width of 10 to 25 feet. Variable widths will be used to create a more natural configuration avoiding ditch-like or canal-like configurations. Sideslope angles will also be varied from 2H:1V (50 percent) to 5H:1V (20 percent). Small depressions will be constructed along the longitudinal profile of each channel to increase the water retention period at these locations. If necessary, small flow barriers (detention dikes) as proposed for the Miller Gulch Tributary mitigation site will be constructed to create additional diversity in wetland hydrology by creating longer periods of inundation or saturation upstream of the dike. If scouring occurs at the outlets of the channels, rock energy dissipators will be construted. Figure 3-7 presents a conceptual cross section at the Lower Rock Creek mitigation site.

Excavated material from the channels will be used in flow barrier construction, for fill on the access road or other mine or facility construction activity. If not needed for construction, the material will be bermed adjacent to the channels in non-wetland areas and will be graded to blend with natural topography and revegetated.

FIGURE 3-7

Soil Handling

Topsoil at the site will be salvaged to a depth of about 12 inches. The gravelly silty loam to sandy loam soils will be stored adjacent to the channels until excavation and grading are complete. The topsoil will then be respread over all disturbed areas at the site. Since soil storage would be of short duration, fertilization is not proposed. Respread soils will be disced or harrowed to prepare a proper seedbed.

Hydrophytic Vegetation Establishment

The linear mitigation sites will be revegetated using the herbaceous wetland revegetation mix (Table 3-4). The proximity of Rock Creek to the area will allow for natural reinvasion of additional hydrophytic species. Sideslopes will be seeded with the upland herbaceous mix presented in the Rock Creek Project Application for Operating Permit/Plan of Operations.

Since the narrow configuration of the mitigation sites would preclude effective drill seeding, broadcast seeding (hand-held seeder or hydroseeder) will be used. The sites will be mulched with noxious weed-free straw (2000 pounds/acre) or cellulose fiber (hydromulch at 1500 pounds/acre).

Re-establishment of Functions and Values

The Lower Rock Creek wetland mitigation site, in conjunction with the Miller Gulch Tributary wetland mitigation site, will function to replace the primary wetland functions and values associated with nearby linear wetlands filled during the placement of tailing within the tailing disposal area. A discussion of wetland functions and values associated with these existing wetlands is in Section 1.4. The re-establishment of wetland functions and values at the Miller Gulch Tributary wetland mitigation site is discussed in Section 3.2.1

As characteristic of the nearby affected wetlands, wetland hydrology will be provided by precipitation, snowmelt runoff and temporary saturation or inundation during the growing season. Created wetlands will provide habitat diversity for herptiles, small and large mammals, and limited seasonal waterfowl and shorebird habitat. The site will also provide habitat for aquatic macroinvertebrates.

The Lower Rock Creek wetland mitigation site is generally located between USFS Road 150B and Rock Creek and its associated riparian/wetland areas along the lower portions of the Rock Creek drainage. Public access to the Rock Creek drainage during the life of the mining operations will be via the proposed new mine access road located on the east side of Rock Creek. Use of the USFS Road 150B will be limited to project-related vehicles necessary for operation and maintenance of the tailing disposal facilities. It is not anticipated that project-related vehicle use of USFS Road 150B will significantly affect the intended wildlife use of the new wetland site for beneficial habitat.

The life of the new wetland site is anticipated to extend well beyond the life of the mining project. Routine monitoring of the site during the life of the mining project will occur to determine whether sediment retention or other factors may be diminishing the functional life of the site. If problems are noted, corrective measures will be explored and implemented. These measures could include the creation of additional mitigation wetlands at other locations.

3.3 WETLAND MITIGATION SCHEDULE

Mitigation wetlands will be created prior to substantial impact to existing wetlands by project construction. Table 2-3, in Section 2.3 lists wetlands impacted by project development. Proposed design modifications in the tailing storage facility result in incremented wetland impact over the life of the project as opposed to previous designs whereby most wetland impacts occurred earlier in project development.

The proposed mitigation schedule for the three (3) sites is:

Mitigation Site	Mitigation Site Construction[1]	Projected Resumption of Comparable Functions
Upper Rock Creek		
Stage 1[2]	Preproduction Year 1	Preproduction Year 4
Stage 2	Preproduction Year 3	Production Year 1
Lower Rock Creek	Preproduction Year 5	Production Year 3
Miller Gulch Tributary	Preproduction Year 3	Production Year 22[3]

[1]Schedule is based on 5 years of preproduction activity, 30 years of production and 5 years of post-production closure and reclamation.

[2]Upper Rock Creek Stage 1 will involve 1.1 acres of mitigation. Stage 2 will include the remaining 3.3 acres and will address any changes necessary based on results of Stage 1 mitigation.

[3]This mitigation site is proposed as a forested wetland and 25 years are projected to allow trees to develop to provide comparable functions as disturbed forested wetlands.

In order to determine feasibility of creating wetlands at the sites, Demonstration Cells will be constructed. The proposed schedule for constructing the Cells is:

Mitigation Site	Demonstration Cell Construction	Seeding/Planting
Upper Rock Creek	November 1996	April-June 1997
Lower Rock Creek	Preproduction Year 3	Preproduction Year 3
Miller Gulch Tributary	Preproduction Year 1	Preproduction Year 1

3.4 WETLAND MITIGATION SITE MONITORING

3.4.1 Performance Criteria

The following minimal criteria for measuring success of wetland creation will be used:

1) The area of wetland creation should not be less than a 1:1 ratio to directly and indirectly impacted wetlands.

2) Reestablished wetlands should meet the 1987 COE criteria for a wetland.

3) Within a five-year period, percent vegetative cover should be equal to or greater than a) the percent cover of impacted wetlands or b) suitable reference area wetlands.

4) Within a five-year period, vegetative species composition and diversity should closely approximate the composition and diversity of impacted wetlands. This will be evaluated by field comparisons of plant species lists and cover of dominant species between created wetlands and either a) impacted wetlands or b) suitable reference areas.

3.4.2 As-Built Reporting

Within six weeks of the completion of each wetland mitigation site, a report will be submitted to the appropriate agencies describing as-built status of each mitigation site. Topographic maps showing as-built contours (at 2-foot intervals) of each mitigation area will be provided. The maps will identify the location and types of planting and any other installation of mitigation features.

3.4.3 Monitoring

Following construction, wetland mitigation sites will be monitored annually for five years to evaluate the success of mitigation to ensure that wetland functions and values are established and maintained. Thereafter, monitoring will be conducted every two years through the end of mining and production, unless it is mutually agreed with the regulatory agencies that final success criteria have been met. When it has been agreed that final success criteria have been met, Wetland Conservation Easements will be established for each new wetland site.

A photographic record will be established for wetland mitigation work. The record will include a) a photograph of affected wetlands prior to impact for documentation and comparison purposes, b) use of color film, c) photographs of mitigation wetlands during the mid-to-late growing season to depict development and diversity, d) photographs from fixed reference points, and e) photographs in monitoring reports.

Annual monitoring reports presenting monitoring results, including wetland hydrology, soils (fertility and stability) and vegetation establishment will be submitted to the U.S. Army Corps of Engineers. The schedule for submittal of the annual monitoring reports will be determined through consultation with the U.S. Army Corps of Engineers following approval of the mitigation plan. The reports will assess both attainment of yearly target criteria and progress toward final success criteria.

If the annual performance criteria are not met for all or any portion of the wetland mitigation plan in any year, or if the final success criteria are not met, an analysis will be prepared addressing the cause(s) of failure, and, if determined necessary by the appropriate agencies, a remedial action proposed for approval. Asarco has identified three (3) optional potential mitigation areas in the event that additional areas of wetland creation become necessary (Figure 3-1).

<u>Hydrology</u>

The most pragmatic measure of the success of wetland hydrology development will be observation of the development of wetland vegetation communities. In a very basic way, success of wetland vegetation will indicate if saturation/inundation of the mitigation areas satisfies wetland criteria. However, because vegetation communities may take several seasons to fully develop, duration and frequency of saturation/inundation will be monitored to determine if the wetlands are performing as designed and if wetland hydrologic criteria are met.

Staff gages and piezometers will be installed at each site to monitor depth of inundation and saturation. Monitoring will be conducted twice monthly through the snowmelt runoff and growing season (approximately March through October).

Soils

Topsoil stockpiled for longer than six months will be sampled for macronutrient content following redistribution to formulate any necessary amendments.

If plant nutritional deficiencies are noted during vegetation monitoring, macro- and micronutrient testing will be conducted and appropriate corrective measures will be implemented, e.g. fertilization, following consultation with involved agencies.

Soil monitoring will include:

- Measuring depth of respread soil;
- Noting soil color and texture; and
- Evaluating soil loss, especially in channels and slopes, to determine if corrective measures are necessary. Soil loss will be evaluated qualitatively using evidence such as rilling, gullying, plant pedestaling, removal of litter and percent bare ground.

Vegetation

Both qualitative and quantitative vegetation monitoring will be conducted to evaluate species composition, cover (by species and morphological class) and shrub and tree density on wetland mitigation areas. Vegetation monitoring will be conducted during summer to early autumn (June-October). Sampling sites will be established within each revegetation type (forested or herbaceous). U.S. Forest Service Ecodata methods (USDA Forest Service 1987) will be used, although plot size may need to be reduced from the standard 0.1-acre circular plot to reflect size or configuration of reestablished types.

Monitoring will also include qualitative assessments of noxious weeds, wildlife damage and other factors that may be influencing revegetation success. If such factors are identified, a plan for corrective action will be developed and implemented in consultation with the involved agencies.

3.5 WETLAND MITIGATION SITE MANAGEMENT

3.5.1 Short-Term Management

Following implementation of the wetland mitigation plans, wetland monitoring will be conducted to verify the establishment of appropriate wetland parameters. Post-establishment management of these wetland mitigation areas (to assure the perpetuation of wetland functions and values) will be carried out until it has been determined, based upon monitoring efforts, that the final success criteria have been met. Monitoring results will be reviewed with involved wetland regulatory agencies, and a decision reached cooperatively between the involved parties concerning the re-establishment of suitable wetlands.

Specific short-term management will address noxious weed control, grazing control and mitigation of any other conditions that may adversely affect wetland restoration.

Noxious weeds, especially spotted knapweed, are abundant in the vicinity of the mitigation sites. Most noxious weeds in the area, however, do not tolerate saturated soils and should not pose a significant threat to reestablished wetlands. Noxious weeds found during monitoring will be controlled. Control methods will stress mechanical or biological control in preference to chemical control, depending on site conditions and land ownership. The applicant will cooperate with the USFS and Sanders County Weed Control Board to develop and implement appropriate noxious weed control measures.

The wetland mitigation sites are not grazed by domestic livestock and fencing is not proposed for site protection. If wildlife grazing or browsing appears to be affecting revegetation success, site-specific control measures will be implemented, including but not limited to selective fencing, seedling protection caps or screens or chemical repellents.

If rills or gullies form on graded slopes or channels, selective filling and/or erosion control procedures (erosion control mats or nets, mulching, straw bales, filter fences or slash filter windrows) will be installed as necessary.

Specific remediation plans will be prepared for any site where problems develop. Such plans will be prepared in consultation with involved regulatory agencies.

3.5.2 Long-Term Management

Prior to a determination that final success criteria have been met, and release of any reclamation bond held for the wetland mitigation sites, management will be the primary responsibility of the applicant with input from the regulatory agencies and land owners or land management agency. Following a determination that final success criteria have been met, and bond release, management will revert to the landowner or management agency. For those wetland mitigation

sites that are privately-owned, Wetland Conservation Easements will be established. The applicant will work with involved owners and agencies to develop long-term management plans providing for continued protection of the mitigation sites.

3.6 REFERENCES

ASARCO Incorporated, Northwest Mining Department. March 1993. Wetlands Inventory, Consideration of Alternatives and Mitigation Plan, Rock Creek Project, Sanders County, Montana.

Hammer, D.A. (ed.). 1989. Constructed wetlands for wastewater treatment: municipal, industrial, and agricultural. Proceedings from the First International Conference on Constructed Wetlands for Wastewater Treatment, Chattanooga, TN. June 13-17, 1988. 831 pp.

Hammer, D.A. 1992. Creating freshwater wetlands. Lewis Publishers, Inc., Chelsea, Michigan. 298 pp.

Hydrometrics, Inc. 1992. 1990-1991 Annual report, water resources baseline study, Asarco Rock Creek project. June 1992.

Kentula, M.E., R.P. Brooks, S.E. Gwin, C.C. Holland, A.D. Sherman and J.C. Sifneos. 1992. Wetlands: An approach to improving decision making in wetland restoration and creation. Edited by A.J. Hairston, USEPA, Corvallis, Oregon. Island Press, Washington, D.C. 151 pp.

Montana Department of Environmental Quality and Kootenai National Forest. September 1995. Draft Environmental Impact Statement. Rock Creek Project, ASARCO Incorporated, Sanders County, Montana.

Montana Native Plant Society (MNPS). 1992. Source guide for native plants. MNPS, Bozeman, Montana. 15 pp.

Reed, P.B., Jr. 1988b. National list of plant species that occur in wetlands: Montana. U.S. Fish and Wildlife Service, Washington, D.C. Biol. Rpt. NERC-88/18.26.

USDA Forest Service. 1987. Ecodata classification handbook 2090.11. USDA For. Serv. Region 1, Missoula, MT.

TABLE 3-3. FORESTED WETLAND REVEGETATION MIXTURE, ROCK CREEK PROJECT, SANDERS COUNTY, MONTANA.

SPECIES[1]			WETLAND STATUS	SEEDING RATE[2]	
Scientific Name	**Variety**	**Common Name**		**Pounds PLS/acre**	**PLS/sq.ft.**
GRASSES:					
Agropyron trachycaulum	-	Slender wheatgrass	FAC	2.00	7
Agrostis alba	-	Redtop	FACW	0.25	28
Deschampsia caespitosa	-	Tufted hairgrass	FACW	0.50	29
Elymus canadensis	-	Canada wildrye	FAC	4.00	10
Festuca arundinacea	-	Tall fescue	FACU-	3.00	16
FORBS:					
Lotus corniculatus	-	Birdsfoot trefoil	FAC	1.00	10
			TOTAL	**10.75**	**100**
SHRUBS:				PLANTING RATE (stems/acre)	
Alnus sinuata	-	Alder	FACW	150	
Cornus stolonifera	-	Red-osier dogwood	FACW	150	
TREES:					
Thuja plicata	-	Western red cedar	FAC	200	
Populus trichocarpa	-	Black cottonwood	FAC	200	
			TOTAL	**700**	

[1]The following species will be added to the mix or planted as containerized stock depending on availability: *Carex lenticularis* (FACW+), *Carex disperma* (FACW), *Carex pachystachya* (FAC), *Elymus glaucus* (FACU) and *Glyceria elata* (FACW+).

[2]Based on a broadcast rate of 100 PLS (pure live seed) per square foot; rate will be halved for drill seeding.

TABLE 3-4. HERBACEOUS WETLAND REVEGETATION MIXTURE, ROCK CREEK PROJECT, SANDERS COUNTY, MONTANA.

SPECIES[1]			WETLAND STATUS	SEEDING RATE[2]	
Scientific Name	**Variety**	**Common Name**		**Pounds PLS/acre**	**PLS/sq.ft.**
GRASSES:					
Agropyron trachycaulum	-	Slender wheatgrass	FAC	2.00	7
Agrostis alba	-	Redtop	FACW	0.25	28
Alopecurus pratensis	-	Meadow foxtail	FACW	0.75	10
Deschampsia caespitosa	-	Tufted hairgrass	FACW	0.25	14
Festuca rubra	-	Red fescue	FAC	1.50	21
Poa ampla	Sherman	Big bluegrass	FACU	0.50	10
FORBS:					
Lotus corniculatus	-	Birdsfoot trefoil	FAC	1.00	10
			TOTAL	**9.25**	**100**

[1]The following species will be added to the mix or planted as containerized stock depending on availability: *Calamagrostis canadensis* (FACW+), *Scirpus microcarpus* (OBL), *Carex lenticularis* (FACW+), *Carex lanuginosa* (OBL) and *Carex pachystachya* (FAC).

[2]Based on a broadcast rate of 100 PLS (pure live seed) per square foot; rate will be halved for drill seeding.

APPENDIX 3-1

MILLER GULCH TRIBUTARY WETLAND MITIGATION SITE WATER BALANCE MODEL

APPENDIX 3-2

LOWER ROCK CREEK WETLAND MITIGATION SITE
ANNUAL WATER BALANCE