United States Department of Agriculture
Forest Service
Kootenai National Forest
31374 US Highway 2
Libby, MT 59923

Montana Department of Environmental Quality
PO Box 200901
Helena, MT 59620-0901

File Code: 1950
February 25, 2009

Dear Interested Party,

The Kootenai National Forest (KNF) and the Montana Department of Environmental Quality (DEQ) have completed the Montanore Project Draft Environmental Impact Statement (Draft EIS). The Montanore Project is a proposed copper and silver underground mine located about 18 miles south of Libby near the Cabinet Mountains of northwestern Montana. Either a Summary or the full Draft EIS is enclosed for your review and comment. Three mine alternatives and a No Action Alternative (No Mine) and four transmission line alternatives and a No Action Alternative (no transmission line) are analyzed in detail.

The KNF and U.S. Army Corps of Engineers (Corps) will use this information to determine whether to issue approvals necessary for construction and operation of the Montanore Project. The KNF's preferred mine alternative is Alternative 4, Agency Mitigated Little Cherry Creek Impoundment Alternative, provided it could be permitted by the Corps. The mine is currently covered by an existing state operating permit. Therefore, the DEQ did not identify a preferred mine alternative. The DEQ will use this information to determine whether to revise the existing state operating permit for the mine and to authorize construction of the transmission line. The DEQ selected Alternative D, Miller Creek Transmission Line Alternative as the preferred transmission line alternative. Public acceptance of a transmission line is one criterion used to locate a transmission line. Thus, identification of Alternative D is tentative, pending public comment. The Bonneville Power Administration will use the information to decide whether to build a new substation and loop line, and to provide power to its customer, Flathead Electric Cooperative, which would provide power to the mine.

Your comments will be invaluable to the agencies as they prepare the Final EIS and Record of Decision. Comments must be postmarked or received 90 days from the date the Notice of Availability of the DEIS is published in the Federal Register. The Notice of Availability will be published on February 27, 2009 and the 90-day comment period will end on May 28, 2009.

Written comment can be submitted to Bobbie Lacklen, Kootenai National Forest, 31374 U.S. 2 West, Libby, MT 59923-3022, or by email to: r1_montanore@fs.fed.us, or to DEQ at: deqmontanoreEIS@mt.gov. Comments can also be faxed to (406) 283-7709, or hand-delivered to either the KNF or the DEQ between the hours of 8:00 a.m. and 4:30 p.m.

As outlined in 36 CFR 215.13, only those who submit timely comments will be accepted by the Forest Service as appellants following the release of the Montanore Project Final EIS and Record of Decision. Comments must be specific to the proposed activities and area being analyzed. Comments should include: (1) name, address, telephone number, and organization represented, if any; (2) title of the document on which the comment is being submitted; (3) specific facts and supporting reasons for the Responsible Official to consider; and (4) signatures.

All comments become part of the public record associated with this project, and are available for public review, along with the name(s) of the commenter(s). Comments submitted anonymously will be accepted and considered; however, those who submit anonymous comments will not have standing to appeal the subsequent decision under 36 CFR 215.12.

Thank you for taking time to be involved with the Montanore Project. For more information or to request a copy of the Draft EIS, please contact one of the Project Coordinators, Bobbie Lacklen, 406-283-7681, or Bonnie Lovelace, MT DEQ, PO Box 200901, Helena MT 59620, by phone at 406-444-1760 or by email at blovelace2@mt.gov.

Sincerely,

Carri Winslow
for PAUL BRADFORD
Forest Supervisor

RICHARD H. OPPER
Director, DEQ

enclosure

Draft Environmental Impact Statement for the Montanore Project

Volume I

Summary

Chapter 1: Purpose and Need

Chapter 2: Alternatives, Including Proposed Action

Chapter 3: Affected Environment and Environmental Consequences, through Section 3.9, Geotechnical



Cabinet Mountains *Photo by M. Holdeman*

United States Department of Agriculture
Forest Service
Northern Region

Kootenai National Forest

Montana Department of Environmental Quality

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Environmental Impact Statement For The Montanore Project

Kootenai National Forest
Lincoln County, MT

Lead Agencies:	USDA Forest Service, Kootenai National Forest Montana Department of Environmental Quality	
Cooperating Agencies:	U.S. Army Corps of Engineers Bonneville Power Administration Lincoln County, Montana	
Responsible Officials:	Paul Bradford Kootenai National Forest 31374 U.S. 2 Libby MT, 59923-3022	Richard Opper Montana DEQ PO Box 200901 Helena, MT 59620-0901
For Information Contact:	Bobbie Lacklen Kootenai National Forest 31374 U.S. 2 Libby, MT 59923-3022 406-283-7681	Bonnie Lovelace Montana DEQ PO Box 200901 Helena, MT 59620-0901 406-444-1760

Abstract: The Montanore Project Draft Environmental Impact Statement (Draft EIS) describes the land, people, and resources potentially affected by Montanore Minerals Corporation's (MMC) proposed copper and silver mine (Montanore Project). As proposed, the project would consist of eight primary components: the use of an existing evaluation adit, an underground mine, a mill, three additional adits and portals, a tailings impoundment, access roads, a transmission line, and a rail loadout. Three mine alternatives and a No Action Alternative (No Mine) and four transmission line alternatives, plus a No Action Alternative (no transmission line), are analyzed in detail.

The Kootenai National Forest (KNF) and U.S. Army Corps of Engineers (Corps) will use this information to determine whether to issue approvals necessary for construction and operation of the Montanore Project. The KNF's preferred mine alternative is Alternative 4, Agency Mitigated Little Cherry Creek Impoundment Alternative, provided it could be permitted by the Corps. The mine is currently covered by an existing state operating permit. Therefore, the Montana Department of Environmental Quality (DEQ) did not identify a preferred mine alternative. The DEQ will use this information to determine whether to revise the existing state operating permit for the mine and to authorize construction of the transmission line. DEQ selected Alternative D, Miller Creek Transmission Line Alternative as the preferred transmission line alternative. Public acceptance of a transmission line is one criterion used to locate a transmission line. Thus, identification of Alternative D is tentative, pending public comment. The Bonneville Power Administration will use the information to decide whether to build a new substation and loop line, and to provide power to its customer, Flathead Electric Cooperative, which would provide power to the mine.

Reviewers should provide the KNF and the DEQ with their comments during the review period of the Draft EIS. This will enable the KNF and the DEQ to analyze and respond to the comments at one time and to use the information acquired in the preparation of the final environmental impact statement (Final EIS), thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act (NEPA) and Montana Environmental Policy Act (MEPA) process so that it is meaningful and alerts the agency to the reviewers' position and contentions [Vermont Yankee Nuclear Power Corp. v. Natural Resource Defense Council, 435 U.S. 519, 553 (1978)]. Environmental objections that could have been raised at the Draft EIS stage may be waived if not raised until after completion of the Final EIS. [City of Angoon v. Hodel (9th Circuit, 1986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980)]. Comments on the Draft EIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 Code of Federal Regulations (CFR) 1503.3).

Send Comments to: Bobbie Lacklen
Kootenai National Forest
31374 U.S. 2
Libby MT 59923-3022

Date Comments Must Be Received: May 28, 2009

Summary

Purpose and Need for Action

Background

This document presents a summary of the Draft Environmental Impact Statement (Draft EIS) for the proposed Montanore Project. As a summary, it cannot provide all of the detailed information contained in the Draft EIS. If more detailed information is desired, please refer to the Draft EIS and the referenced reports. For any remaining questions or concerns, contact the individuals listed in the last section of this summary, *Where to Obtain More Information.*

The U.S. Department of Agriculture (USDA), Kootenai National Forest (KNF), and the Montana Department of Environmental Quality (DEQ) have prepared the Draft EIS in compliance with the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA). These laws require that if any action taken by the DEQ or the KNF may "significantly affect the quality of the human environment," an environmental impact statement must be prepared. This Draft EIS also has been prepared in compliance with the USDA NEPA policies and procedures (7 Code of Federal Regulations (CFR) part 1b), the Forest Service's Environmental Policy and Procedures Handbook (Forest Service Handbook 1909.15), DEQ's MEPA regulations (Administrative Rules of Montana (ARM) 17.4.601 *et seq.*), and the U.S. Army Corps of Engineers' (Corps) NEPA implementation procedures for its regulatory program (Appendix B of 33 CFR 325). Two "lead" agencies have been designated for this project: the KNF and the DEQ. Cooperating agencies are the Bonneville Power Administration (BPA), Corps, and Lincoln County, Montana. A single Draft EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before construction and operation of the proposed project could begin, various other permits, licenses, or approvals from the two lead agencies and other agencies would be required.

The Proposed Action, the Montanore Project, is a proposed copper and silver underground mine and associated transmission line located about 18 miles south of Libby near the Cabinet Mountains of northwestern Montana. The ore body is beneath the Cabinet Mountains Wilderness (CMW). All access and surface facilities would be located outside of the CMW boundary. Montanore Minerals Corp. (MMC), a wholly owned subsidiary of Mines Management, Inc. (MMI), would be the project operator.

The discovery of mineral deposits for the Montanore Project dates back to the early 1980s. In 1980, Heidelberg Silver Mining Company (Heidelberg) located certain mining claims in sections 29 and 30 of Township 27 North, Range 31 West, M.M., Sanders County, Montana. Subsequently, in 1983, Pacific Coast Mines, Inc. (Pacific), a subsidiary of U.S. Borax and Chemical Corporation (Borax), located other mining claims in sections 29 and 30 of Township 27 North, Range 31 West, M.M., Sanders County, Montana. The mining claims located by Pacific in 1983 included the lode mining claims Hayes Ridge (HR) 133 and HR 134 adjacent to Rock Lake. (These claims are shown on Figure 11 in the EIS.) This outcrop contained stratabound copper-silver mineralization, extending over a 200-foot vertical thickness.

In 1984, Pacific leased Heidelberg's mining claims pursuant to the terms of a 1984 Lease and Option to Purchase Agreement (Lease Agreement). Subsequently, in 1988, Heidelberg was merged into Newhi, Inc. (Newhi), a subsidiary of Mines Management, Inc. (MMI). As a result of that merger, Newhi became the successor in interest to Heidelberg under the Lease Agreement. Also in 1988, Pacific assigned its interest in HR 133 and HR 134 and its interest in the Lease Agreement to Noranda Minerals Corporation (Noranda), a subsidiary of Noranda Finance Inc. (Noranda Finance).

In 2002, Noranda terminated the Lease Agreement with Newhi. Pursuant to the terms of that agreement, Noranda conveyed its interest in HR 133 and HR 134 to Newhi. In 2006, Newhi acquired all of the issued and outstanding shares of Noranda. Immediately following the acquisition of Noranda, Noranda's name was changed to Montanore Minerals Corporation (MMC).

The permitting process for the Montanore Project began in 1989. In that year, Noranda obtained an exploration license from the Montana Department of State Lands (DSL) and other associated permits for construction of an exploration adit from private land in upper Libby Creek. Soon after obtaining the exploration license, Noranda began excavating the Libby Adit. Noranda also submitted a "Petition for Change in Quality of Ambient Waters" (Petition) to the Board of Health and Environmental Sciences (BHES) requesting an increase in the concentration of select constituents in surface and ground water above ambient water quality, as required by Montana's 1971 nondegradation statute. After constructing about 14,000 feet of the Libby Adit, Noranda ceased construction in 1991 in response to elevated nitrate concentration in surface water and low metal prices.

Although construction ceased in 1991, the permitting process continued. Specifically, the KNF, the Montana Department of Health and Environmental Sciences (DHES), the Montana Department of Natural Resources and Conservation (DNRC), and the DSL, DEQ's predecessor agency, prepared a Draft, Supplemental Draft, and Final EIS on the proposed project. The environmental review process culminated in 1992 with BHES's issuance of an Order approving Noranda's Petition (BHES 1992) and the DSL's issuance of a Record of Decision (ROD) and Hard Rock Operating Permit #00150 (DSL 1992) to Noranda. In 1993, the KNF issued its ROD (KNF 1993), the DNRC issued a Certificate of Environmental Compatibility and Public Need under MFSA (DNRC 1993), and the U.S. Army Corps of Engineers issued a 404 permit (Corps 1993). These decisions selected mine and transmission line alternatives that allowed for the construction, operation, and reclamation of the project.

The BHES Order, issued to Noranda in 1992, authorized degradation and established nondegradation limits in surface and ground water adjacent to the Montanore Project for discharges from the project (BHES 1992). The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc (both surface and ground water), as well as nitrate (ground water only), and total inorganic nitrogen (surface water only). Pursuant to BHES's Order, these nondegradation limits apply to all surface and ground water affected by the Montanore Project and remain in effect during the operational life of the mine and for so long thereafter as necessary (BHES 1992). The Order also adopted the modification developed in Alternative 3, Option C, of the Final EIS, addressing surface and ground water monitoring, fish tissue analysis, and in-stream biological monitoring. The Order is presented in Appendix A in the EIS.

In 1997, a Montana Pollutant Discharge Elimination System (MPDES) permit was issued to Noranda by the DEQ (MT-0030279) to allow discharges of water flowing from the Libby Adit to Libby Creek. Three outfalls were included in the permit: Outfall 001 – percolation pond; Outfall 002 – infiltration system of buried pipes; and Outfall 003 – pipeline outlet to Libby Creek. Surface discharge from the adit ceased in 1998 and water in the adit flowed to the underlying ground water.

Apart from the permitting process, Noranda filed an application for patent with the Bureau of Land Management (BLM) in 1991 for lode claims HR 133 and HR 134 (Patent Application MTM 80435). In 1993, a Mining Claim Validity Report was issued by BLM recommending that BLM issue patent to Noranda for HR 133 and HR 134. In 2001, a patent was issued to Noranda for the portion of HR 134 that lies outside the CMW (Patent Number 25-2001-0140) and a separate patent was issued to Noranda for the mineral deposits for HR 133 and the portion of HR 134 that lies inside the CMW (Patent Number 25-2001-0141).

As discussed above, Noranda conveyed its interests in lode claims HR 133 and HR 134 to Newhi in 2002. By that time, many of Noranda's permits for the Montanore Project terminated or expired, such as DEQ's air quality permit, the Corps' 404 permit, KNF's approval, and the State's certification of the transmission line. In 2002, Noranda notified the KNF it was relinquishing the authorization to operate and construct the Montanore Project. Noranda's DEQ Operating Permit #00150 and MPDES permit were not terminated because reclamation of the Libby Adit was not completed.

Proposed Action

In 2005, MMI submitted an application for a hard rock operating permit to the DEQ and a proposed Plan of Operations for the proposed Montanore Project to the KNF. MMI also submitted to the DEQ an application for a 230-kV transmission line certificate of compliance, an application for an air quality permit, and an application for a MPDES permit that covered additional discharges not currently permitted under the existing MPDES permit for the Libby Adit.

In 2006, Newhi acquired all of the issued and outstanding shares of Noranda pursuant to the terms of a Stock Transfer Agreement between Noranda Finance, Newhi, and MMI. Although the name of Noranda was changed to Montanore Minerals Corporation (MMC) immediately following Newhi's acquisition of Noranda's shares, MMC (formerly Noranda) remains the holder of DEQ Operating Permit #00150 and the MPDES permit for the Montanore Project.

MMI and MMC advised the agencies that MMC will be the owner and operator of the Montanore Project. Consistent with that indication, Newhi has re-conveyed HR 133 and HR 134 to MMC, and MMI and MMC have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC for modification to DEQ Operating Permit #00150. MMC submitted an updated Plan of Operations to the agencies in 2008 that clarified differences between the 2005 Plan of Operations and DEQ Operating Permit #00150. It also incorporated plans required by DEQ Operating Permit #00150 and additional environmental data collected since 2005. With minor exceptions, MMC proposes to construct, operate, and reclaim a new mine and transmission line in accordance with the terms and conditions of DEQ Operating Permit #00150 and in accordance with the terms and conditions of the other agencies' permits and

approvals issued to Noranda in 1992 and 1993. The requested changes to DEQ Operating Permit #00150 are:

- Construction of an additional underground ventilation infrastructure that would disturb about 1 acre of private land near Rock Lake
- Relocation of the concentrate loadout facility to the Kootenai Business Park located in Libby (private land) resulting in less than 1 acre of disturbance
- Installation of a buried powerline along the Bear Creek Road (NFS road #278), which would be reconstructed for access
- Construction of a temporary electrical substation adjacent to the Ramsey Creek Road (NFS road #4781), which would be reconstructed for access
- A change in the construction technique proposed for the Little Cherry Creek Impoundment from downstream to centerline
- Installation of a water pipeline from the Libby Adit to the land application and disposal (LAD) Areas

Other changes may be required to conform Operating Permit #00150 to the alternative selected by the KNF. MMC and the DEQ agreed to hold the request for modification to the permit in abeyance until completion of the environmental review process.

MMC's Plan of Operations is considered as a new Plan of Operations by the KNF because Noranda relinquished the federal authorization to construct and operate the Montanore Project in 2002. Both the KNF and the DEQ consider MMC's proposed 230-kV North Miller Creek transmission line to be part of the Proposed Action as the 1993 Certificate of Environmental Compatibility and Public Need for the 230-kV transmission line expired.

Libby Adit Evaluation Program

Following the acquisition of Noranda and DEQ Operating Permit #00150, MMC submitted, and the DEQ approved in 2006, two requests for minor revisions to DEQ Operating Permit #00150 (MR 06-001 and MR 06-002). The KNF has not approved any activities at the Libby Adit that may affect National Forest System lands. The revisions involved reopening the Libby Adit and re-initiating the evaluation drilling program that Noranda began in 1989. The key elements of the revisions include: excavation of the Libby Adit portal; initiation of water treatability analyses; installation of ancillary facilities; dewatering of the Libby Adit decline; extension of the current drift; and underground drilling and sample collection.

The KNF determined the activities associated with the Libby Adit evaluation drilling were a new proposed Plan of Operations under the Federal Locatable Minerals Regulations (36 CFR 228 Subpart A), and MMC needed KNF approval prior to dewatering and continuing excavation, drilling, and development work at the Libby Adit. Under the authority of Minor Revision 06-002 of the DEQ operating permit, MMC has installed a water treatment plant and is allowed to treat free flowing water from the adit.

In 2006, the KNF initiated a NEPA analysis that included public scoping for the proposed road use and evaluation drilling at the Libby Adit Site. In 2008, the KNF decided the best approach for disclosing the environmental effects of the Libby Adit evaluation program was to consider this

activity as the initial phase for the overall Montanore Project EIS. The Libby Adit evaluation program would be the first phase of the Montanore Project in Alternatives 3 and 4.

Purpose and Need

The Forest Service's and DEQ's overall purpose and need is to process MMC's Plan of Operations, permit applications and application for modification of DEQ Operating Permit #00150, and follow all applicable laws, regulations, and policies pertaining to each pending application. The need, from the perspective of the Forest Service, is to:

- Respond to MMC's proposed Plan of Operations to develop and mine the Montanore copper and silver deposit
- Ensure the selected alternative would comply with other applicable federal and state laws and regulations
- Ensure the selected alternative, where feasible, would minimize adverse environmental impacts on National Forest System surface resources
- Ensure measures would be included, where practicable, that provide for reclamation of the surface disturbance

In accordance with the Clean Water Act, the Corps is required to consider and express the activity's underlying purpose and need from the applicant's and public's perspectives. From the Corps' perspective, the underlying project purpose is to provide copper and silver from deposits contained in northwestern Montana in an economically viable manner to meet a portion of current and future public demands.

The MEPA and its implementing rules ARM 17.4.601 *et seq.*, require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project. MMC's project purpose is described below. Benefits of the proposed project include increased employment in the project area, increased tax payments, and the production of copper and silver to help meet public demand for these metals. The Major Facility Siting Act (MFSA) (75-20-101 *et seq.*, Montana Code Annotated (MCA) and an implementing rule, ARM 17.20.920, require that the DEQ determine the basis of the need for a facility and that an application for an electric transmission line contain an explanation of the need for the facility. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

BPA's transmission system in northwestern Montana provides reliable power to BPA's customers. BPA has a need therefore to improve its transmission system to ensure continued reliable electrical power for all of its customers. BPA's purposes are goals to be achieved while meeting the need for the project; the goals are used to evaluate the alternatives proposed to meet the need.

MMC's project purpose is to develop and mine the Montanore copper and silver deposit by underground mining methods with the expectation of making a profit. MMC's need is to receive all necessary governmental authorizations to construct, operate, and reclaim the proposed Montanore Mine and the associated transmission line, and all other incidental facilities. MMC proposes to construct, operate, and reclaim the Montanore Project in an environmentally sound

manner, subject to reasonable mitigation measures designed to avoid or minimize environmental impacts to the extent practicable.

Decisions

The KNF Supervisor will issue a decision on MMC's proposal in a ROD. The decision objective is to select an action that meets the legal rights of MMC, while protecting the environment in compliance with applicable laws, regulations, and policy. The KNF Supervisor will use the EIS process to develop the necessary information to make an informed decision as required by 36 CFR 228, Subpart A. The Corps will decide whether to provide a 404 permit based on MMC's 404 permit application and information in this EIS. MMC will submit a Section 404 permit application to the Corps for the alternative selected by the lead agencies. The Corps will issue a ROD on its permit decision. Before deciding to provide a tap for electrical power for MMC's project, the BPA will prepare a decision document for its part of the project. The U.S. Fish and Wildlife Service (USFWS) will decide if implementation of the project would jeopardize the continued existence of any species listed or proposed as threatened or endangered under the Endangered Species Act (ESA), or adversely modify critical or proposed critical habitat for a threatened or endangered species, based on a biological assessment (BA) prepared by the KNF. The DEQ will issue a ROD containing its decisions pursuant to each of the project-related permit applications including MMC's MFSA certificate of compliance application, MPDES, air quality, and other permit applications, and a decision on MMC's application for modification of DEQ Operating Permit #00150.

Public Involvement

A Notice of Intent was published in the *Federal Register* on July 15, 2005. The Notice described KNF and DEQ's intent to prepare an EIS for the proposed Montanore Project, set the dates for public scoping meetings, and solicited public comments. In addition, as part of the public involvement process, the lead agencies issued press releases, mailed scoping announcements, and held three public meetings. Based on the comments received during public scoping, the KNF and the DEQ identified seven key issues that drove alternative development. The key issues that led the lead agencies to develop alternatives to the Proposed Action were:

- Issue 1: Potential for acid rock drainage and near neutral pH metal leaching
- Issue 2: Effects on quality and quantity of surface and ground water resources
- Issue 3: Effects on fish and other aquatic life and their habitats
- Issue 4: Changes in the project area's scenic quality
- Issue 5: Effects on threatened and endangered wildlife species
- Issue 6: Effects on wildlife and their habitats
- Issue 7: Effects on wetlands and non-wetland waters of the U.S.

Alternatives

Alternatives were developed based on requirements for alternatives under regulations implementing NEPA, MEPA, MFSA, and Section 404 of the Clean Water Act. To develop a reasonable range of alternatives, the agencies separated the proposed Montanore Project into components. Components are discrete activities or facilities (*e.g.*, plant site or tailings

impoundment) that, when combined with other components, form an alternative. Options were identified for each component. An option is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as paste tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. The agencies considered options for the following project components:

- Underground mine
- Plant site and adits
- Tailings disposal methods and impoundment location
- Land application disposal areas
- Access road
- Transmission line

Besides a No Action and a Proposed Action for both the mine facilities and transmission line, the lead agencies analyzed in detail two mine alternatives and three transmission line alternatives.

Mine Alternatives

Alternative 1—No Action, No Mine

Under this alternative, MMC would not develop the Montanore Project, although it is approved under DEQ Operating Permit #00150. The Montanore Project cannot be implemented without a corresponding KNF approval of the Plan of Operations. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the mine or a transmission line. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the KNF could select Alternative 1 or DEQ deny the MPDES and air quality permits, transmission line certificate, and MMC's operating permit modifications are described in section 1.6, *Agency Roles, Responsibilities, and Decisions* of Chapter 1 of the EIS.

Alternative 2—MMC's Proposed Mine

As proposed by MMC, the Montanore Project would consist initially of a 12,500-tons-per-day underground mining operation that would expand to a 20,000-tons-per-day rate. The surface mill (the Ramsey Plant Site) would be located on National Forest System lands outside of the CMW in the Ramsey Creek drainage. The proposed project also would require constructing about 16 miles of high-voltage electric transmission line from a new substation adjacent to BPA's Noxon-Libby transmission line to the project site. The 230-kilovolt (kV) transmission line alignment would be from the Sedlak Park Substation in Pleasant Valley along U.S. 2, and then up the Miller Creek drainage to the project site. The proposed transmission line is considered as a separate alternative below (see Alternative B). The location of the proposed project facilities is shown on Figure S-1.

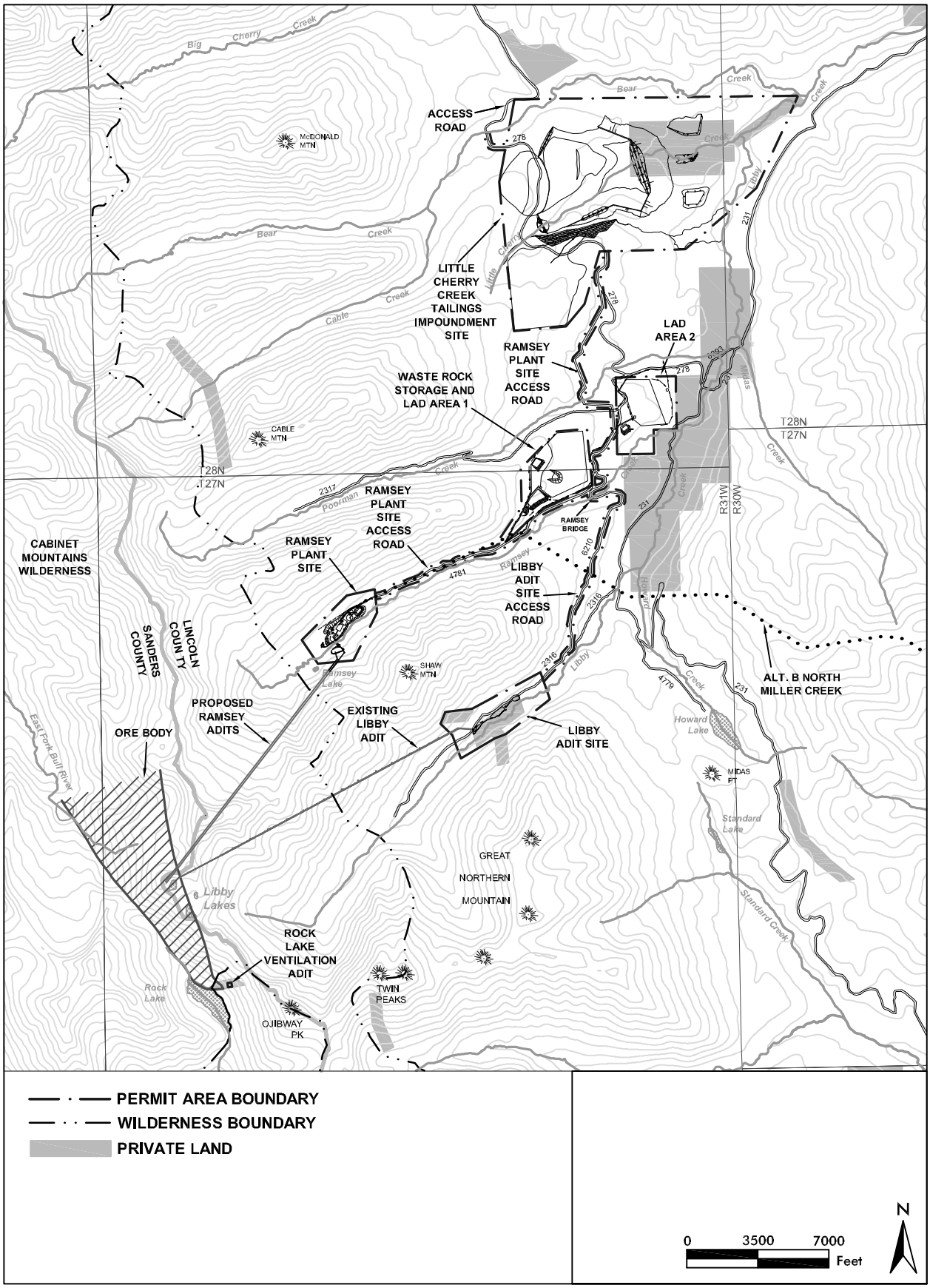


Figure S-1. Mine Facilities and Permit Areas, Alternative 2

The ore body would be accessed from two adits adjacent to the mill. Two other adits, an evaluation/ventilation adit and a ventilation adit, both with entrances located on private land, also would be used during the project. The evaluation/ventilation adit would be located in the upper Libby Creek drainage; the ventilation adit would be located on MMC's private land (patented claim HR 134) in the upper East Fork Rock Creek drainage near Rock Lake. The additional 1-acre disturbance for the ventilation adit is part of MMC's requested DEQ Operating Permit #00150 modifications.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the surface plant located near the Ramsey Adits. Copper and silver minerals would be removed from the ore by a flotation process. Tailings from the milling process would be transported through a pipeline to a tailings impoundment located in the Little Cherry Creek drainage, about 4 miles from the Ramsey Plant Site.

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. (Road names and numbers are used interchangeably in this EIS; a complete list of all road names and numbers is in Appendix B in the EIS.) With the exception of the Bear Creek Road, all open roads in the proposed operating permit areas would be gated and limited to mine traffic only. MMC would upgrade 11 miles of the Bear Creek Road and build 1.7 miles of new road between the Little Cherry Creek Tailings Impoundment Site and the Ramsey Plant Site. Silver/copper concentrate from the plant would be transported by truck to a rail siding in Libby, Montana. The rail siding and Libby Loadout facility are near one of the facilities considered in the 1992 Final EIS. The concentrate would then be shipped by rail to an out-of-state smelting facility.

MMC would discharge excess mine and adit wastewater at one of two LAD Areas. Additional water treatment would be added as necessary prior to discharge at the LAD Areas. Water treatment also would continue at the Libby Adit Site, if necessary. MMC would be required to submit a complete MPDES application for all additional outfalls. Additional proposed discharges include the LAD Areas, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment Site should this alternative be selected.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

The operating permit area would be 3,628 acres and the disturbance area would be 2,582 acres (Table S-1). The operating permit area would encompass 433 acres of private land owned by MMC for the proposed mine and associated facilities. All surface disturbances would be outside the CMW. MMC has developed a reclamation plan to reclaim disturbed areas.

Table S-1. Mine Surface Area Disturbance and Operating Permit Areas, Alternatives 2-4.

Facility	Alternative 2		Alternative 3		Alternative 4	
	Disturbance Area[†] (acres)	Permit Area (acres)	Disturbance Area[†] (acres)	Permit Area (acres)	Disturbance Area[†] (acres)	Permit Area (acres)
Existing Libby Adit Site	22	219	22	219	22	219
Upper Libby Adit	0	0	1	1	1	1
Rock Lake Ventilation Adit	1	1	1	1	1	1
Plant Site and Adits	52	185	110	172	110	172
Tailings Impoundment	1,928	2,458	1,359	1,585	1,602	2,191
LAD Area 1 and Waste Rock Storage Area[§]	247	261	260	277	260	277
LAD Area 2	183	226	123	196	123	196
Access Roads[†]	149	278	135	155	135	188
Total	2,582	3,628	2,011	2,606	2,254	3,245

[†]Disturbance area shown for roads excludes 33 feet of existing disturbance along roads.
[§]Waste rock would be stored within the disturbance area of the tailings impoundment in Alternatives 3 and 4, and not at LAD Area 1.

Alternative 3—Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate modifications and mitigating measures proposed by the agencies to reduce or eliminate adverse environmental impacts. These measures are in addition to or instead of the mitigations proposed by MMC. The Libby Adit evaluation program would be the initial phase of the project and would be completed before construction of any other project facility. All other aspects of MMC's mine proposal would remain as described in Alternative 2.

In Alternative 3, four major mine facilities would be located in alternative locations (Figure S-2). MMC would develop a Poorman Tailings Impoundment Site north of Poorman Creek for tailings disposal, use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed operating permit and disturbance areas at LAD Areas 1 and 2 to avoid important resources (Figure S-3). The Poorman Tailings Impoundment Site was retained for detailed analysis because it would avoid the diversion of a perennial stream (Issue 2) and minimize wetland effects (Issue 7). In Alternative 2, MMC's proposed tailings impoundment would be in Little Cherry Creek, a perennial stream, and the impoundment would require the permanent diversion of the upper watershed of Little Cherry Creek. Numerous wetlands and springs are in the Little Cherry Creek Impoundment Site.

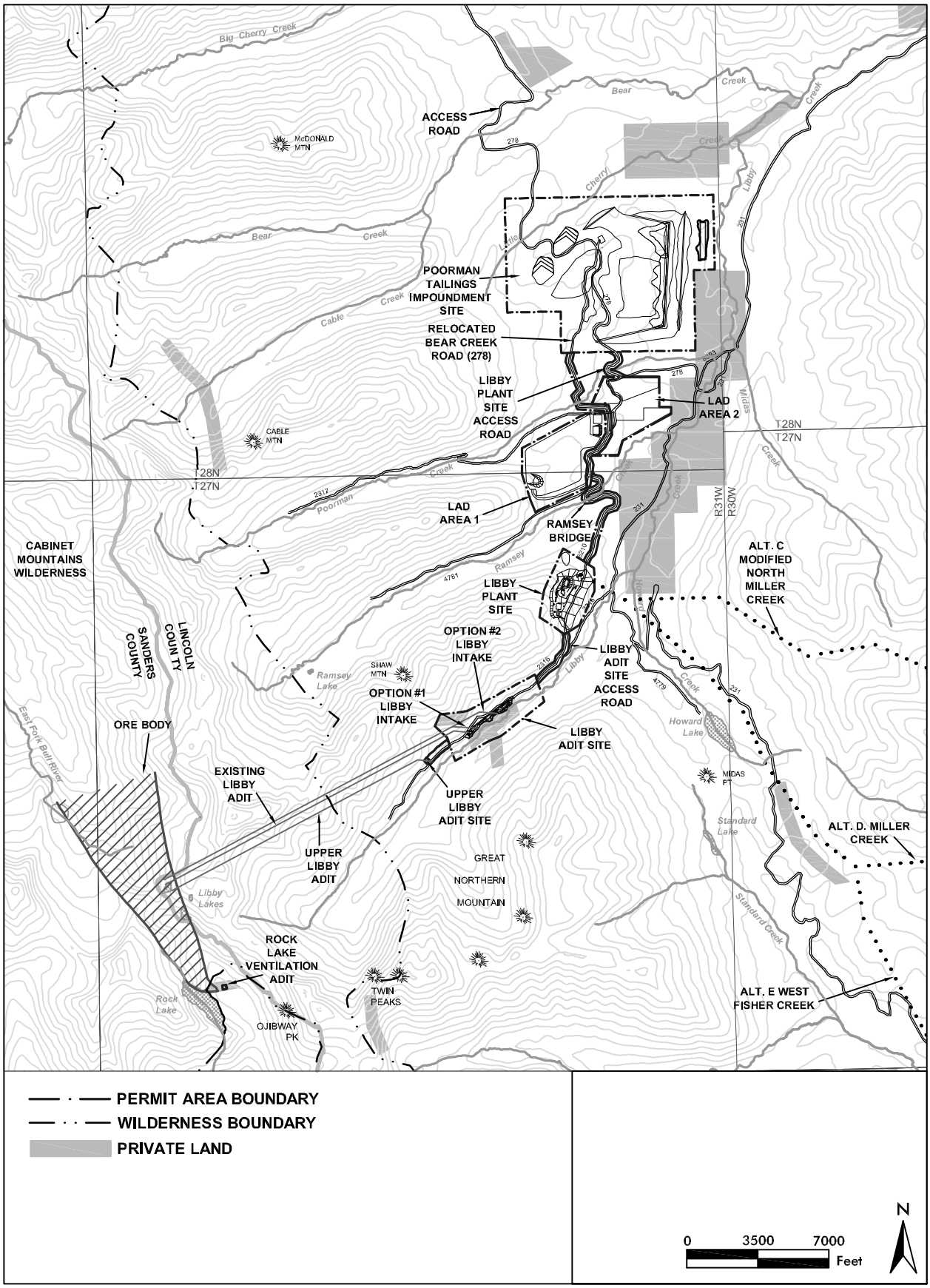


Figure S-2. Mine Facilities and Permit Areas, Alternative 3

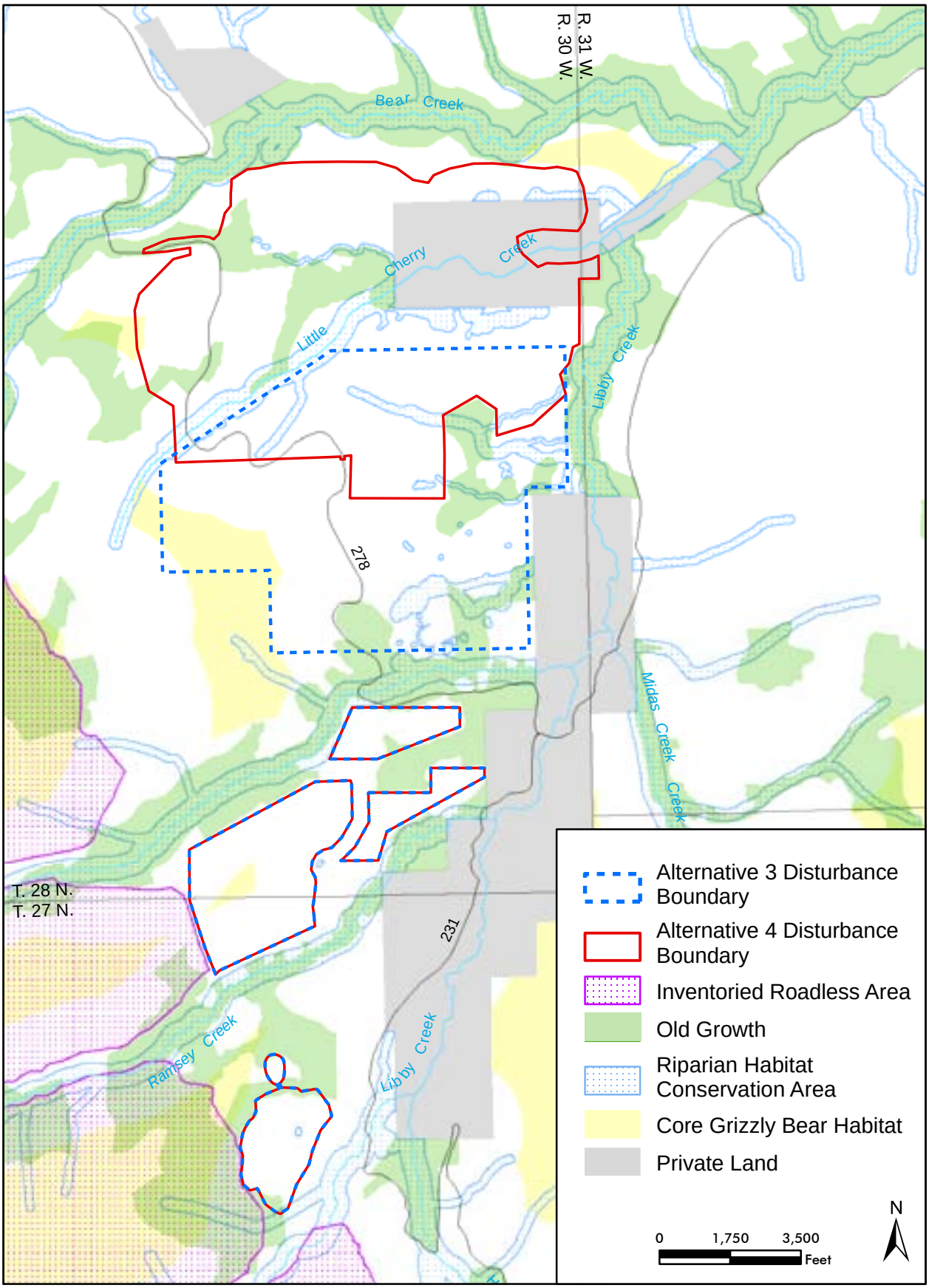


Figure S-3. Key Resources Avoided by Alternatives 3 and 4

MMC's proposed plant site in the upper Ramsey Creek drainage would affect Riparian Habitat Conservation Areas (RHCAs) (Issue 3), core grizzly bear habitat (Issue 5), and Inventoried Roadless Areas (IRAs). An alternative site on a ridge separating Libby and Ramsey creeks was retained for detailed analysis to address these issues. Preliminary evaluation indicates the Libby Plant Site could be built of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction. Avoiding the use of waste rock in plant site construction would address acid rock drainage and metal leaching (Issue 1). To avoid disturbance in the upper Ramsey Creek drainage, the adits in Alternative 3 would be in the upper Libby Creek drainage. This modification would address the same issues as the alternate Libby Plant Site (Issues 3 and 5).

MMC's proposed LAD Area 1 would disturb RHCAs (Issue 3), old growth (Issue 6), and IRAs; LAD Area 2 would disturb old growth. In Alternative 3, the lead agencies modified the permit areas and disturbance areas for the LAD Areas to address these issues (Figure S-3).

In Alternative 2, MMC would discharge mine and adit wastewater from the Ramsey Adits at two LAD Areas. Water would be treated at the Libby Water Treatment Plant or a water treatment plant at the Ramsey Plant Site if necessary to meet MPDES discharge limitations. In Alternatives 3 and 4, the lead agencies modified the proposed water management plan to address the uncertainties about quality of the mine and adit inflows, the effectiveness of LAD for primary treatment, quantity of water that the LAD Areas would be capable of receiving and the effect on surface and ground water quality. In Alternatives 3 and 4, in addition to the existing water treatment plant at the Libby Adit, another water treatment system may be necessary at higher wastewater volumes to comply with water quality standards or BHES Order limits prior to disposal at the LAD Areas. These modifications would address Issue 2, water quality and quantity.

The operating permit area would be 2,606 acres and the disturbance area would be 2,011 acres (Table S-1). The operating permit area would encompass 83 acres of private land owned by MMC for the proposed mine and associated facilities.

MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. MMC would install a gate on the Libby Creek Road and maintain the gate and the KNF would seasonally restrict access on the two roads as long as MMC uses and snowplows the two roads.

In Alternative 3, MMC would use the same roads as Alternative 2 for main access during operations. About 13 miles of Bear Creek Road (National Forest System road #278), from U.S. 2 to the Poorman Tailings Impoundment Site, would be paved and upgraded to a roadway width of 26 feet. South of Little Cherry Creek, MMC would build 3.2 miles of new road west of Bear Creek Road that would connect Bear Creek Road with Ramsey Creek Road (NFS road #4781). The new road would be designated NFS road #278 (the new Bear Creek Road) and would generally follow the 3,800-foot contour to north of the Poorman Creek bridge. To maintain a public access connection between the Bear Creek Road and the Libby Creek Road (NFS road #231), the public would use the new Bear Creek Road, a segment of the Poorman Creek Road (NFS road #2317), and a segment of the Bear Creek Road south of Poorman Creek.

Alternative 4—Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. As in Alternative 3, the Libby Adit evaluation program would be the initial phase of the project and would be completed before construction of any other project facility.

In Alternative 4, MMC would use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed permit and disturbance areas at the LAD Areas, as in Alternative 3 (Figure S-4). In addition to the modifications from Alternative 3, MMC would modify the proposed Little Cherry Creek Tailings Impoundment Site operating permit and disturbance areas to avoid RHCAs (Issue 3) and old growth (Issue 6) in the Little Cherry Creek drainage. Borrow areas would be reconfigured to maximize disturbance within the impoundment footprint, and to minimize disturbance of RHCAs (Issue 3), core grizzly bear habitat (Issue 5), and old growth (Issue 6) (Figure S-3). Waste rock would be stored temporarily within the impoundment footprint to address acid rock drainage and metal leaching (Issue 1) and water quality and quantity (Issue 2). The proposed permanent Little Cherry Creek Diversion Channel below the engineered upper section would be modified so it would adequately convey anticipated flows. At closure, surface water runoff would be directed toward the Little Cherry Creek Diversion Channel, and not Bear Creek, an important bull trout stream. The operating permit area would be 3,245 acres and the disturbance area would be 2,254 acres (Table S-1). The operating permit area would encompass 433 acres of private land owned by MMC for the proposed mine and associated facilities. All other aspects of MMC's mine proposal would remain as described in Alternative 2, as modified by Alternative 3.

A comparison of primary mine development and operation features that vary between each mine alternative is shown in Table S-2.

Transmission Line Alternatives

Alternative A—No Transmission Line, No Mine

In this alternative, MMC would not build a 230-kV transmission line to provide power. The BPA would not tap the Noxon-Libby 230-kV transmission line nor would it build the Sedlak Park Substation. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the transmission line. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

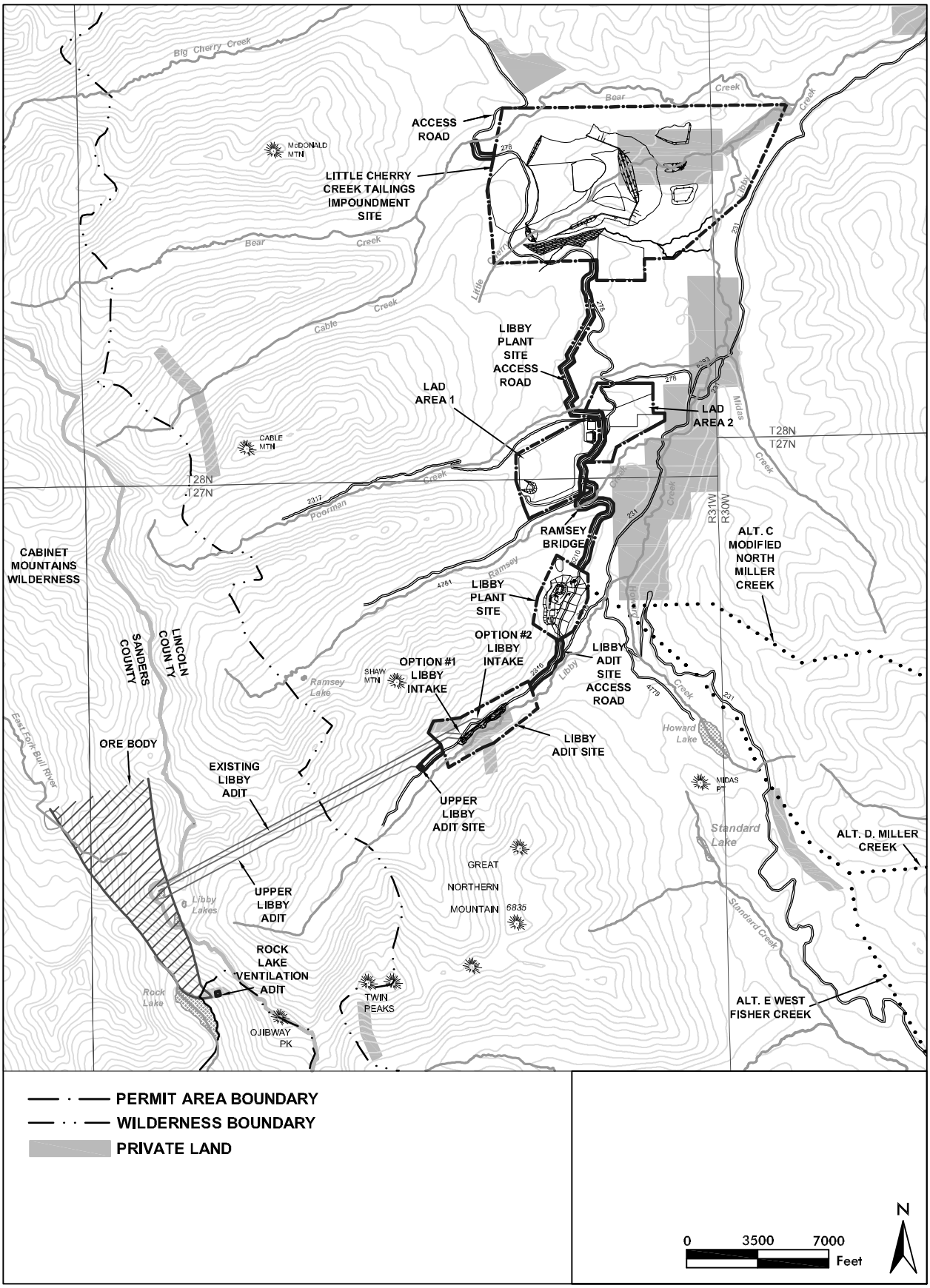


Figure S-4. Mine Facilities and Permit Areas, Alternative 4

Table S-2. Mine Alternative Comparison.

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Operating Permit Areas	3,628 acres	2,606 acres	3,245 acres
Disturbance Areas	2,582 acres	2,011 acres	2,254 acres
Primary Facilities			
Mill site	Ramsey Plant Site in valley bottom in Upper Ramsey Creek	Libby Plant Site between Libby and Ramsey Creek drainages	Same as Alternative 3
Adits and portals	Existing Libby Adit; two Ramsey Adits; Rock Lake Ventilation Adit	Existing Libby Adit; two additional Libby Adits; Rock Lake Ventilation Adit	Same as Alternative 3
Above-ground conveyor	1,200 feet long between Ramsey Adit portal and mill	6,000 and 7,500 feet long (depending on the option) between Libby Adit Site and Libby Plant Site mill	Same as Alternative 3
Tailings impound-ment and seepage collection pond	628 acres in Little Cherry Creek	608 acres between Poorman and Little Cherry creeks	Same as Alternative 2
Perennial stream diversion	Diversion of Little Cherry Creek 10,800 feet long around impoundment to Libby Creek	None	Same as Alternative 2
Land application disposal areas	Two; one along Ramsey Creek and one between Ramsey and Poorman creeks	Two; similar to Alternative 2 with slight boundary modifications	Same as Alternative 3
Water treatment	Land application, Libby Adit Water Treatment Plant, or additional water treatment plant at plant site, as necessary	Same as Alternative 2	Same as Alternative 2

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Primary access road	NFS road #278 (Bear Creek Road) plus new access road; 20 to 29 feet wide	NFS road #278 (Bear Creek Road) plus new access road; 26 feet wide; up to 56 feet wide to accommodate haul traffic and public traffic	Same as Alternative 3
Concentrate loadout location	Kootenai Business Park in Libby	Same as Alternative 2	Same as Alternative 2
Facility Details			
New adits:length, grade, and portal elevation	Ramsey Adits: 16,000 feet long, 8% decline; Elevation: 4,400 feet Rock Lake Ventilation Adit: Elevation: 5,560 feet	Upper Libby Adit: 13,700 feet long, 7% decline; Elevation: 4,100 feet New Libby Adit: 17,000 to 18,500 feet long, depending on option; 5% decline; Elevation: 3,960 feet	Same as Alternative 3
New access roads[†] To Plant Site:	1.7 miles connecting NFS roads #278 and #4781	Existing NFS road #6212 and 4781 used for plant site access	Same as Alternative 2
Realigned NFS road #278 at impoundment	1.8 miles	3.2 miles of new Bear Creek Road connecting existing NFS roads #278 and #4781	Same as Alternative 2
To Adit Portal:	0.3 mile to portal	None	Same as Alternative 3
To LAD Area 1	1.0 mile	0.7 mile	Same as Alternative 3
To LAD Area 2	0.2 mile	0.2 mile	Same as Alternative 3
Pipelines Tailings	Double-walled, high-density polyethylene adjacent to access road; 6.4 miles to impoundment	Double-walled buried adjacent to access road; 4.2 miles to impoundment	Same as Alternative 3; 6.4 miles to impoundment
Reclaim water	High-density polyethylene adjacent to access road	High-density polyethylene buried adjacent to access road	Same as Alternative 3
Tailings pump stations	At Poorman Creek crossing	At each crossing of Ramsey and Poorman creeks	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Borrow areas	Four; 143 acres within impoundment footprint and 419 acres outside of impoundment footprint	Three; 124 acres within impoundment footprint and 92 acres outside of impoundment footprint	Five; 185 acres within impoundment footprint and 252 acres outside of impoundment footprint
Post-mining impoundment runoff	Riprapped channel to Bear Creek	Natural channel to Little Cherry Creek	Riprapped channel to Little Cherry Creek Diversion Channel

†Temporary roads within the disturbance area of each facility not listed.

Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alternative)

The Ramsey Plant Site's electrical service would be 230-kV, 3-phase, and 60-cycle, provided by a new, overhead transmission line. BPA's proposed Sedlak Park Substation Site at the Noxon-Libby 230-kV transmission line is in an area known locally as Sedlak Park, 30 miles southeast of Libby on U.S. 2 (Figure S-5). The proposed Sedlak Park Substation Site is the same in all alternatives. MMC would be responsible for funding construction of the transmission line, substation, and loop line that would connect the substation to the Noxon-Libby 230-kV transmission line.

MMC's proposed transmission line alignment would be in the watersheds of the Fisher River, Miller Creek, a tributary to Miller Creek, Midas Creek, Howard Creek, Libby Creek, and Ramsey Creek (Figure S-5). The proposed alignment would head northwest from the substation for about 1 mile paralleling U.S. 2, and then follow the Fisher River and U.S. 2 north 3.3 miles. The alignment would then turn west and generally follow the Miller Creek drainage for 2.5 miles, and then turn northwest and traverse up a tributary to Miller Creek. The alignment would then cross into the upper Midas Creek drainage, and then down to Howard and Libby Creek drainages. The alignment would cross the low ridge between Libby Creek and Ramsey Creek, and then would generally follow Ramsey Creek to the Ramsey Plant Site. The maximum annual energy consumed by the project is estimated at 406,000 megawatts, using a peak demand of 50 megawatts. Access roads on National Forest System lands would be closed and reseeded after the transmission line was built, and reclaimed after the transmission line was removed at the end of operations.

Characteristics of MMC's proposed North Miller Creek Alternative (Alternative B) and the agencies' three other transmission line alternatives (Alternatives C, D, and E) are summarized in Table S-3. MMC's proposed alignment would end at a substation at the Ramsey Plant Site; the lead agencies' alternatives would end at a substation at the Libby Plant Site, which would result in the lead agencies' alternatives being shorter.

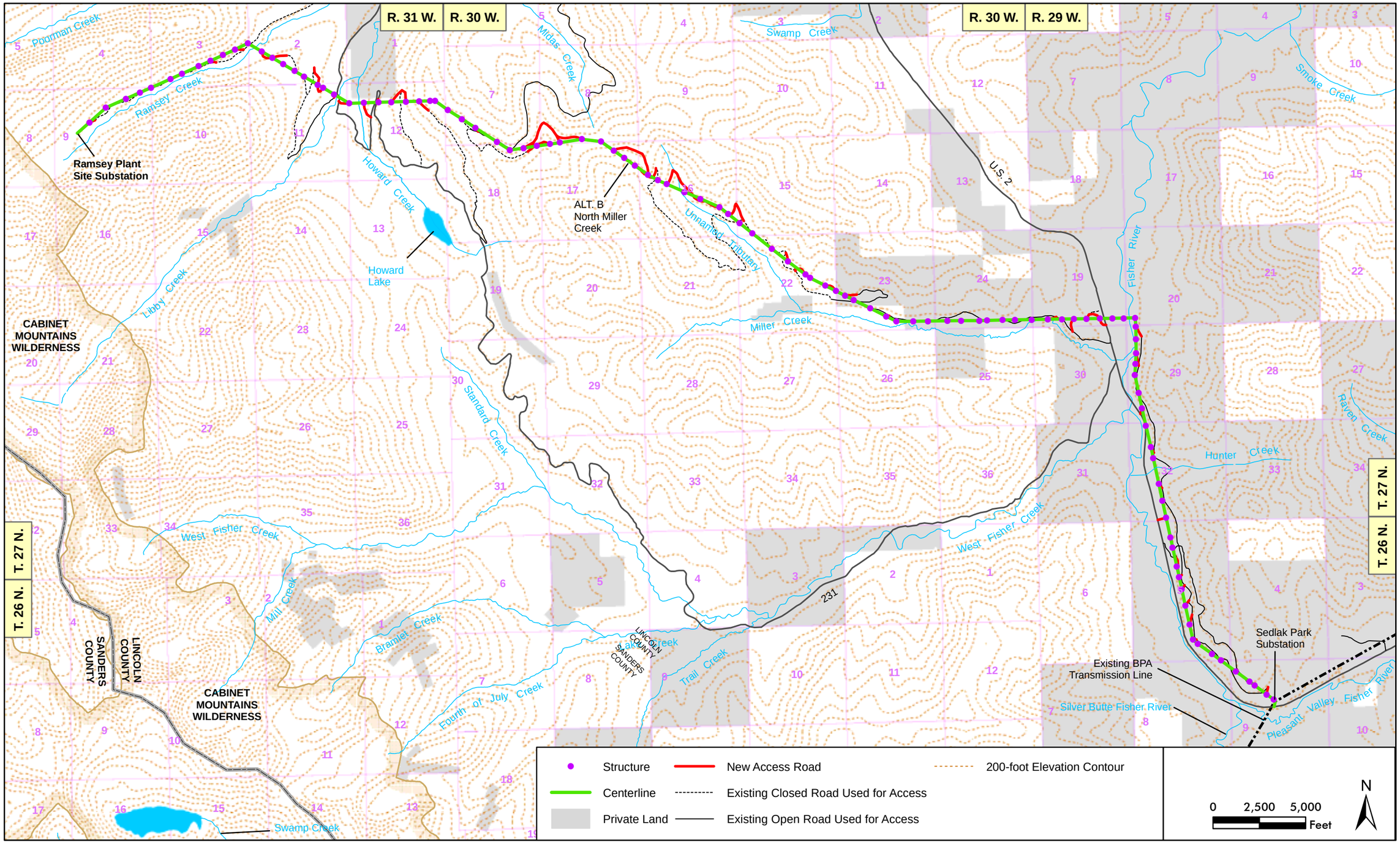


Figure S-5. North Miller Creek Alignment, Structures, and Access Roads, Alternative B

Table S-3. Transmission Line Alternative Comparison.

Characteristic	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Length (miles)[†]				
Steel monopole	16.4	0.0	0.0	1.4
Wooden H-frame	0.0	13.4	14.1	13.5
Total	16.4	13.4	14.1	14.9
Number of structures[‡]	108	80	95	101
Approximate average span length (ft)	800	885	785	780
Helicopter use				
Structure placement	At contractor's discretion	21 structures, primarily in upper unamed tributary of Miller Creek and Midas Creek	20 structures, primarily in upper Miller Creek	23 structures, primarily along West Fisher Creek
Vegetation clearing	At contractor's discretion	At selected locations; see Figure S-6	At selected locations; see Figure S-6	At selected locations; see Figure S-6
Line stringing	At contractor's discretion	Yes, entire line	Yes, entire line	Yes, entire line
Annual inspection	Yes	Yes	Yes	Yes
Estimated cost in millions of 2008 $[¶]				
Construction	$7.3	$5.4	$5.8	$6.0
Mitigation	$14.9	$14.4	$14.5	$15.0

[†]Length is based on line termination at the Ramsey Plant Site in Alternative B and the Libby Plant Site in the other three alternatives.
[‡]Number and location of structures based on preliminary design, and may change during final design. The lead agencies' analysis of MMC's preliminary design and structure locations indicates additional structures and access may be needed to avoid long spans.
[¶]Estimated cost used reasonable assumptions regarding costs of construction materials, clearing, land acquisition, and engineering. Final cost could vary from those shown. Estimated construction cost by HDR Engineering, Inc. 2008; estimated construction cost by ERO Resources Corp. 2008.

Alternative C—Modified North Miller Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal described under Alternative B. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

The primary modification to MMC's proposed North Miller Creek alignment in Alternative B would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation instead of following the Fisher River (Figure S-6). This modification would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The alignment also would be out of the Fisher River floodplain. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Other modifications to the alignment are relatively small shifts along Miller Creek and an unnamed tributary to Miller Creek. During final design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval. The plan's goal would be to minimize vegetation clearing. The modifications were made to avoid and minimize effects on RHCAs along drainages, and to avoid steep slopes in the headwaters of the unnamed tributary of Miller Creek (Issues 2 and 3).

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on Alternative C. In some locations, a helicopter would be used for vegetation clearing and structure construction (Figure S-6). The lead agencies selected helicopter use so the need to use or construct roads in or adjacent to core grizzly bear habitat was eliminated. Helicopter use also would reduce effects on lynx habitat. Access roads on National Forest System lands would be placed into intermittent stored service after construction, and decommissioned after the transmission line was removed at the end of operations. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. Modifications described under Alternative 3 for the mine, such as seed mixtures, revegetation success, and weed control, would be implemented in Alternative C.

The agencies developed mitigation measures that would reduce or minimize the effects of the transmission line in Alternatives C, D, and E. Snags and up to 30 tons per acre of coarse woody debris would be left in the clearing area. No transmission line construction in elk, white-tailed deer, or moose winter range would occur between December 1 and April 30 unless approved by the agencies. The KNF would change the access on five roads to provide big game security habitat. MMC would fund or conduct field and/or aerial reconnaissance surveys to locate any new bald eagle or osprey nests along specific segments of the transmission line corridor. MMC would complete surveys to locate active nests in appropriate habitat, or would not remove vegetation in the nesting season. To mitigate effects on the grizzly bear, MMC would secure or protect replacement grizzly bear habitat on 24 acres of private lands and enhance grizzly bear habitat on 11,324 acres of private lands in the Cabinet-Yaak Ecosystem. The KNF would change the access in 2.8 miles of NFS road #4725 in an unnamed tributary of Miller Creek in Alternative C and 4.2 miles in Alternatives D and E.

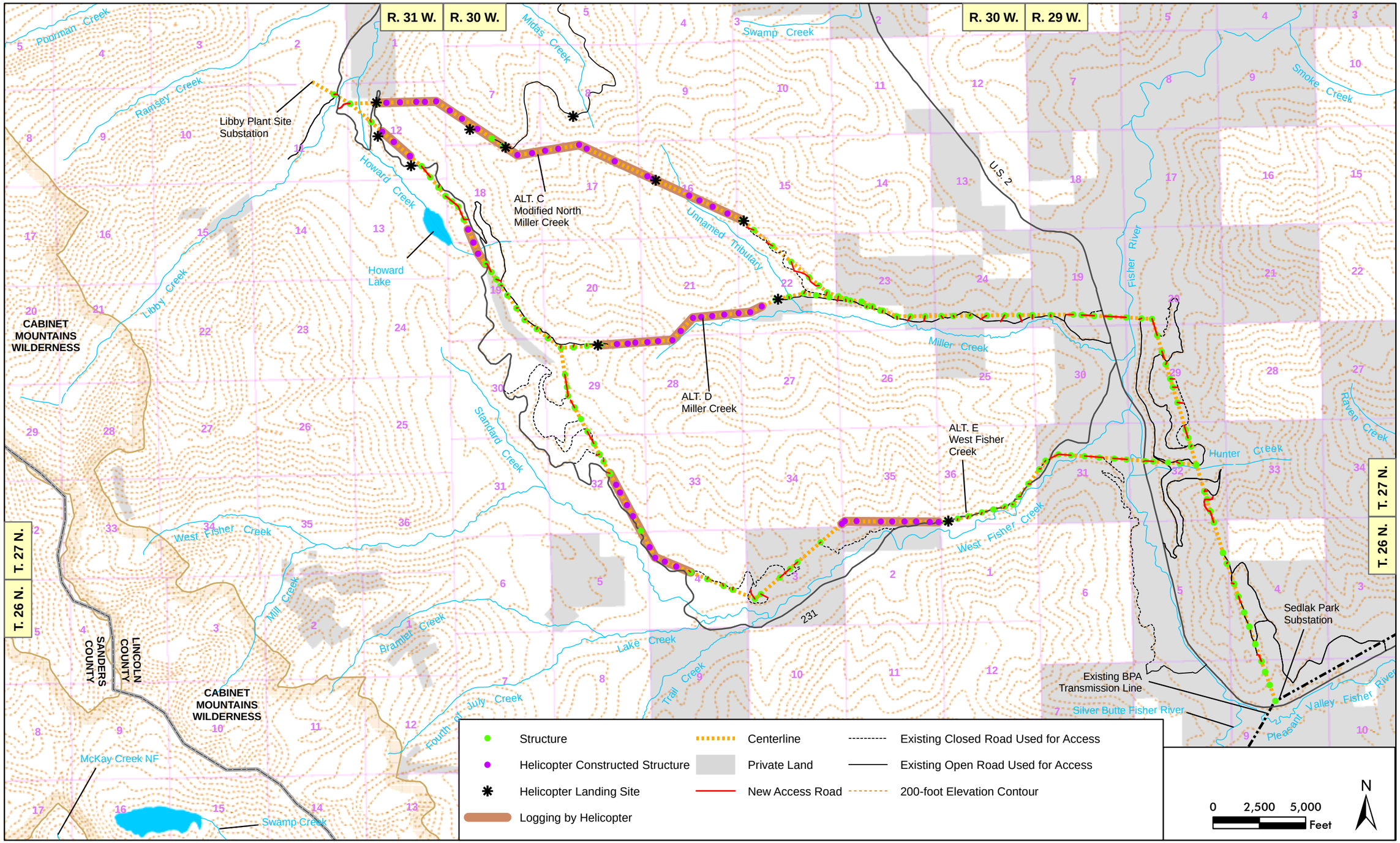


Figure S-6. Transmission Line Alignment, Structures, and Access Roads, Alternatives C-E

Alternative D—Miller Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, and other modifications described under Alternative C. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

As in the Modified North Miller Creek Alternative (Alternative C), this alternative modifies MMC's proposed North Miller Creek alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation (Figure S-6). The development of a final Vegetation Removal and Disposition Plan would be the same as Alternative C. The modifications would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Other modifications to the alignment are relatively small shifts along Miller Creek to avoid RHCAs along drainages (Issue 3). The issue of effects on threatened or endangered species (Issue 5) was addressed by routing the alignment along Miller Creek and avoiding core grizzly bear and lynx habitat in North Miller Creek and the unnamed tributary of Miller Creek.

This alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. In the 1992 Final EIS, a similar alignment was considered, but was eliminated in part because of visual concerns from Howard Lake. The issue of scenic quality from Howard Lake was addressed by using H-frame structures, which would be shorter than steel monopoles. More detailed engineering was completed and H-frame structures would be used to minimize the visibility of the line from Howard Lake (Issue 4).

As in Alternative C, a helicopter would be used for timber clearing and structure construction in some locations (Figure S-6). New access roads on National Forest System lands would be managed in the same manner as Alternative C. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads.

Alternative E—West Fisher Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, and other modifications described under Alternative C. Some steel monopoles would be used in the steep section 2 miles west of U.S. 2 (Figure S-6). This alternative could be selected with any of the mine alternatives. For analysis purposes, the lead agencies assumed this alternative would terminate at the Libby Plant Site.

As in the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. The modification would address issues associated with water quality (Issue 2) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line.

The primary difference between the West Fisher Creek Alternative (Alternative E) and the North Miller Creek Alternative (Alternative B) is routing the line on the north side of West Fisher Creek

and not up the Miller Creek drainage to minimize effects on core grizzly bear habitat. As in the Miller Creek Alternative (Alternative D), this alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on this alternative in most locations to minimize the visibility of the line from Howard Lake (Issue 4). In some locations, a helicopter would be used for timber clearing and structure construction (Figure S-6). New access roads on National Forest System lands would be managed in the same manner as Alternative C. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads.

Forest Plan Amendment

Each mine and transmission line alternative would require an amendment to the 1987 Kootenai Land and Resource Management Plan, as known as the Kootenai Forest Plan (KFP) in order for the alternative to be consistent with the plan (USDA Forest Service 1987). The amendment would be completed in accordance with the regulations governing Forest Plan amendments found in 36 CFR 219 and Forest Service Manual 1921.03.

Mine Facilities

In the 1993 ROD approving the lead agencies' preferred alternative for Noranda's proposed Montanore Project, the KNF amended the KFP and reallocated an area surrounding the Little Cherry Creek Tailings Impoundment Site and the Ramsey Plant Site to Management Area 31 (MA 31). Maps showing existing MAs are available at the KNF. MA 31 is designed to accommodate the activities associated with mineral development on the KNF. Because of improved mapping capabilities between 1993 and 2007 and a slight change in the Little Cherry Creek Tailings Impoundment design from that approved in 1993, all areas currently proposed for disturbance at the Ramsey Plant Site and the Little Cherry Creek Tailings Impoundment Site were not previously reallocated to MA 31. In mine Alternatives 2, 3 and 4, the KNF would amend the KFP by reallocating to MA 31 all areas within the operating permit areas of the selected plant site, the tailings impoundment, and LAD Areas 1 and 2 that currently are not MA 31. In addition, a proposed road and facility corridor that would cross MA 13 (Designated Old Growth) would be reallocated to MA 31. This amendment would apply only to National Forest System lands disturbed by any mine alternative, and would not apply to private lands affected by the mine alternatives.

230-kV Transmission Line

In the 1993 ROD approving the lead agencies' preferred alternative for Noranda's proposed Montanore Project, the KNF amended the KFP and reallocated areas crossed by the transmission line classified as corridor avoidance areas (224 acres) to Management Area 23 (MA 23). Maps showing existing MAs are available at the KNF. MA 23 is designed to accommodate the activities associated with electric transmission corridors on the KNF (USDA Forest Service 1987). Because of improved mapping capabilities between 1993 and 2007 and slight changes in the North Miller Creek transmission line alignment from that approved in 1993, all areas currently proposed for disturbance by MMC's proposed transmission line alignment classified as corridor avoidance areas were not reallocated to MA 23. In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by reallocating certain areas within a 500-foot corridor of the selected 230-

kV transmission line on National Forest System lands as MA 23. This amendment would apply only to certain National Forest System lands currently not MA 23 disturbed by any transmission line alternative, and would not apply to private lands crossed by the transmission line alternatives. The amendment would apply to the following MAs if crossed by the transmission line under the conditions described:

- MAs 10 and 11 if the proposed corridor is within grizzly bear Management Situation 1 or 2
- MAs 2, 6, 12, 13, and 14

The KFP requires wildlife habitat and security be maintained in MAs 15, 16, 17, and 18 by limiting open road density (ORD) to less than or equal to 3.0 miles per square mile. ORD in MAs 15, 16, 17, and 18 is currently greater than the standard in the Crazy Planning Subunit (PSU), which is a KNF planning area potentially affected by the proposed project. In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by allowing the ORD to exceed the KFP standard in the Crazy PSU during and after the project.

Affected Environment

The project is in the KNF, 18 miles south of Libby, Montana. Elevation of the project area ranges from 2,600 feet along U.S. 2 to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is influenced by elevation and topography. Precipitation is between 30 and 50 inches where most project facilities would be located. Two tributaries of the Kootenai River, Libby Creek and the Fisher River, provide surface water drainage for most of the project area. The ore body is beneath the CMW and all access and surface facilities would be located outside of the CMW boundary. The analysis area is drained by East Fork Rock Creek, a tributary of the Clark Fork River, the East Fork Bull River, Libby Creek, and tributaries to the Fisher River. Most of the area is National Forest System lands managed in accordance with the KFP. Private land, most of which is owned by MMC or Plum Creek Timber Company, is found in the project area, particularly along the first 3 to 6 miles of the transmission line corridors. Recreation, wildlife habitat, and timber harvesting are the predominant land uses. Chapter 3 provides more information about the affected environment.

Environmental Consequences

The following two sections summarize the environmental consequences of the four mine and five transmission line alternatives. The effects of the mine alternatives are summarized for the seven key issues discussed in the previous *Public Involvement* section. For the transmission line, the DEQ requires a certificate of compliance for development of electric transmission lines. The DEQ must find that the selected alternative meets the set of criteria listed under 75-20-301, MCA to be eligible for transmission line certification. Findings for all criteria under each alternative are summarized in the following *Draft Findings for Transmission Line Certification Approval* section.

Mine Alternatives

Issue 1: Potential for Acid Rock Drainage and Near Neutral pH Metal Leaching

The mineral deposit proposed for mining is part of the Rock Creek-Montanore deposit. The Rock Creek-Montanore deposit has two sub-deposits, the Rock Lake sub-deposit and the Montanore sub-deposit. The Troy Mine, developed within the upper quartzites of the Revett Formation, is a depositional and mineralogical analog for the zone of quartzite to be mined within the upper-most part of the lower Revett Formation at the Montanore sub-deposit. Geological analogs are valuable techniques for predicting acid generation potential and/or water quality from a proposed mine site. This type of comparison is based on the assumption that mineralization formed under comparable conditions within the same geological formation, and that has undergone similar geological alteration and deformation, will have similar mineralogy and texture and, thus, similar potential for oxidation and leaching under comparable weathering conditions. The ability to study environmental geochemical processes in the same rocks at full scale and under real-time weathering conditions provides a valuable basis for evaluation of laboratory test results.

The risk of acid generation for rock exposed in underground workings or for tailings would be low, with some potential for release of select metals at a near-neutral pH (around pH 7) and a high potential for release of nitrogen compounds due to blasting. Low acid generation potential exists for a fraction of the total waste rock volume in portions of the Prichard Formation and moderate potential exists within the halo zones of the Revett Formation, which MMC proposes to mitigate through selective handling (particularly of the barren lead zone) and additional evaluation by sampling and characterization during mine development and operations. Portions of the waste rock at Montanore have the potential to release trace elements at a near-neutral pH.

Some additional sampling would be conducted during final exploration and operations, when a more representative section of waste rock would be available for sampling. Characterization of metal release potential for tailings and waste rock is limited and would be expanded in Alternatives 3 and 4. Descriptions of mineralogy in rocks exposed in the evaluation adit ore zone (for the Revett Formation) and development adits (for the Burke and Prichard Formations) would be used to identify subpopulations with sulfide halo zone overprints and their relative importance in terms of tonnage to be mined, to guide sampling density. If the Wallace Formation were intercepted, samples of this lithology would be collected and characterized. This information would be used to redefine geochemical units for characterization and evaluate potential selective handling and encapsulation requirements.

Although waste rock would only be stockpiled for a short period of time near LAD Area 1 in Alternative 2, and runoff from that pile would only be contained using stormwater controls, waste rock would be used throughout the site for construction purposes, using selective handling criteria that are not yet defined. It is therefore not clear which fraction of the Revett Formation waste rock would be brought to the surface. Once more detailed information about the Revett and Prichard Formations waste rock is available, along with updated predictions of metal loading for tailings, these source terms would be incorporated into updated mass load calculations.

Issue 2: Quality and Quantity of Surface and Ground Water Resources

Ground Water Levels-Mine Area. The No Mine alternative would not change ground water levels. Disturbances at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals.

The agencies used a two-dimensional model to perform an analysis of the effects to mine area hydrology. A two-dimensional model was used because there were insufficient site data to support a three-dimensional model. The model required a number of simplifying assumptions described in section 3.10, *Ground Water Hydrology* section of Chapter 3.

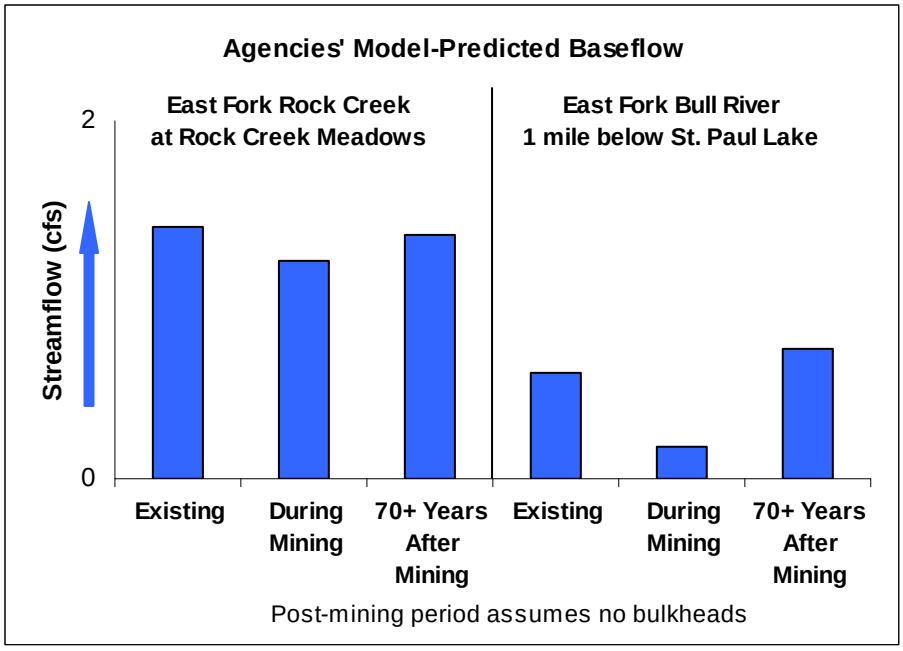
Based on the agencies' model, drawdown due to mine dewatering in Alternatives 2, 3, and 4 is predicted to extend about 2 miles from the mine void in all directions, but along the trend of the proposed adits, drawdown created by the mine void would merge with drawdown created by the adits. Given uncertainties associated with the model, the model cannot precisely predict the final configuration of the drawdown cone around the mine, but the model does provide an indication of the catchment area required to supply about 450 gallons per minute (gpm) to the mine and adits on a steady state basis. If steady state inflow to the mine were higher, a larger catchment would be required to supply that water at the calibrated infiltration rates and hydraulic conductivity. For example, if the steady state inflow were in the range of 800 gpm, as estimated by MMC, the catchment area would be about two times larger than predicted by the agencies' numerical ground water model (using the assumptions inherent in the calibrated version of the model).

An uncertainty in the final shape of the drawdown cone is the assumption in the agencies' numerical model that homogeneous conditions exist in the mine area. As a result of this assumption, the numerical model essentially distributes potential impacts from mine dewatering evenly in all directions. Actual site conditions may vary and ground water drawdown may be subject to some degree of heterogeneity, causing more drawdown along structural trends and less drawdown in other directions. Data are insufficient for the model to predict heterogeneous drawdown.

For those areas where the fractured bedrock water table is currently some depth below ground surface (for all areas above 5,600 feet elevation), ground water drawdown, as predicted by the agencies' numerical model, would not have a direct effect on surface water occurring above this elevation. Because surface and ground water above 5,600 feet elevation appear not to be hydraulically connected, ground water drawdown would not decrease flow to surface water (streams, springs and lakes) in areas above 5,600 feet elevation. Infiltration of precipitation is controlled by the nature of the surface material and overall hydraulic conductivity and, therefore, the infiltration rate would not change in these areas as a result of a lower water table. It is possible that random fractures exist above elevations of 5,600 feet that are saturated between the fractured bedrock water table and the shallow ground water flow path, hydraulically connecting the two ground water flow paths. If this condition were to exist, drawdown of the fractured bedrock water table by mine dewatering could reduce flow to unidentified springs or affect lake levels associated with this type of fracture, such as the Libby Lakes. However, there are no observations, data or numerical model results to indicate this condition exists.

For those areas where ground water is either at the surface or connected hydraulically to shallow ground water flow systems (below an elevation of about 5,600 feet), drawdown due to mine dewatering would decrease the volume of water available to the surface water system, such as springs, lakes, and creeks. The effects of ground water drawdown due to dewatering of the mine

can best be expressed by estimating changes to base flow in streams. Streams in the area flow at base flow for about 1 to 2 months between mid-July to early October; periods of base flow may also occur during November through March. The agencies' model predicts base flow would be reduced in East Fork Rock Creek, East Fork Bull River and Libby Creek in Alternatives 2, 3, and 4, and Ramsey Creek in Alternative 2.



The agencies estimate the area overlying the mine would require slightly more than 20 years to recover to steady state water level conditions after the mine void was filled with water. Based on an estimated inflow rate of about 450 gpm and estimated volume of the final mine void, the mine void would require about 50 years to refill. Ground water levels above the mine void are predicted to return to steady-state conditions about 70 years following mine closure and plugging of the portals. While water levels were recovering, the ground water flow direction in the region would be predominantly toward the mine void and adits and any change in base flow to streams would occur for much of this recovery period. Any change in ground water contribution to streams would decrease through the recovery period as the ground water head in the mine void increased and flow toward the mine void decreased. If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow.

Ground Water Quality-Mine Area. The No Mine alternative would not change ground water quality in the mine area. During the mining period, the risk of measurable changes to ground water quality would be low in Alternatives 2, 3, and 4 because ground water would be moving toward the mine void and adits and then pumped to the surface for use in the ore processing. Any changes in water quality resulting from the mining process, such as an increase in the concentration of nitrogen compounds due to the use of explosives and ground water contact with oxidizing minerals in the ore body, would be removed from the mine void, used in mill processing, and eventually stored, treated, and discharged. Mine dewatering and the resulting drawdown of bedrock ground water could subtlely change water quality of various water bodies, such as Rock Lake, and unidentified springs and seeps. Assuming these water bodies receive water from both shallow and deep ground water sources, reducing the source of deeper ground water could reduce the introduction of certain minerals considered to be necessary for potential populations of organisms. If this water quality change were to occur, it may be difficult to detect or measure. The likelihood for this to occur would be minimized because MMC has committed to advanced

drilling and grouting fracture zones encountered in the mine that would reduce or eliminate the hydrologic impacts to any one area.

If ground water flowed from the filled mine void to the East Fork Bull River, attenuation and dilution of the dissolved metals as it moved about 3,000 feet vertically through fractures would likely reduce concentrations. The actual flow path may be longer than 3,000 feet. The fate and transport of dissolved metals within the flooded mine void cannot be predicted without significant uncertainty, particularly considering the relatively low surface water standards. MMC intends to construct a three dimensional ground water model during the mine development period when additional hydraulic data would be collected. A calibrated model could be used to evaluate the potential for the migration of dissolved metals from the mine void to surface water drainages such as the East Fork Bull River. If modeling were to indicate potential exceedances of surface water standards in nearby streams, various mitigation measures would have to be adopted prior to active mining. The agencies' numerical model indicates that during the post-mining period, there would be the potential for ground water to flow toward the mine void from the East Fork Rock Creek drainage (including Rock Lake). If this were to occur, there may be subtle changes in the water quality of Rock Lake, as described in the previous paragraph.

Ground Water Levels-Tailings Impoundment and LAD Areas. The Little Cherry Creek Tailings Impoundment in Alternatives 2 and 4 is designed with an underdrain system to collect seepage from the tailings impoundment and divert intercepted water to a Seepage Collection Pond below the impoundment. A pumpback well system also would be necessary to collect tailings seepage that reached underlying ground water. Similar underdrain and pumpback well systems would be used at the Poorman Impoundment in Alternative 3. The tailings are expected to be placed in the impoundment with a high water content and as they consolidate, water would pool in low areas at the surface and would percolate downward. Most of the percolating water would be captured by the underdrain system, but some would seep into the underlying fractured bedrock aquifer. Tailings seepage not collected is expected to flow to ground water at a maximum rate of 25 gpm, slowly decreasing to 5 gpm after operations cease. The saturated zone beneath the impoundment would be able to accommodate the addition of 25 gpm from seepage and would respond with a rising water table (increasing the hydraulic gradient or slope of the water table) to convey the additional water from beneath the impoundment. Seepage from the tailings impoundment would enter the ground water system beneath the impoundment and be intercepted by a pumpback well system.

Four known springs and seeps along Little Cherry Creek would be covered by impoundment facilities. Flow from the springs above and below the tailings impoundment would remain relatively stable through the life of the mine.

In Alternatives 2, 3, and 4, mine and adit inflows greater than that needed in the mill or that could be stored in the tailings impoundment would be discharged at two LAD Areas between Ramsey and Poorman Creek. Ground water levels in the LAD Areas would rise, and increase the hydraulic gradient. The flow rate from springs between the two LAD Areas may increase. The increase in ground water levels would be a function of the application rate used at the LAD Areas. The agencies' analysis indicates the rates proposed by MMC in Alternative 2 would likely result in surface water runoff or increased spring and seep flow on the downhill flanks of the LAD Areas. In Alternatives 2, 3, and 4, the maximum application rate would be determined on a performance basis by monitoring both water quality and quantity changes to ground water. It is possible that monitoring would determine that the maximum application rate is higher or lower

than estimated by the agencies' analysis. The LAD application rates would be selected to ensure that ground water did not discharge to the surface as springs between the LAD Areas and downgradient streams.

Ground Water Quality-Tailings Impoundment and LAD Areas. No ground water users have been identified in the analysis area. Private land immediately downgradient of the Little Cherry Creek Tailings Impoundment Site in Alternatives 2 and 4 is owned by MMC. Private land immediately downgradient of LAD Area 2 in all alternatives and downgradient of the Poorman Impoundment Site in Alternative 3 is not owned by MMC.

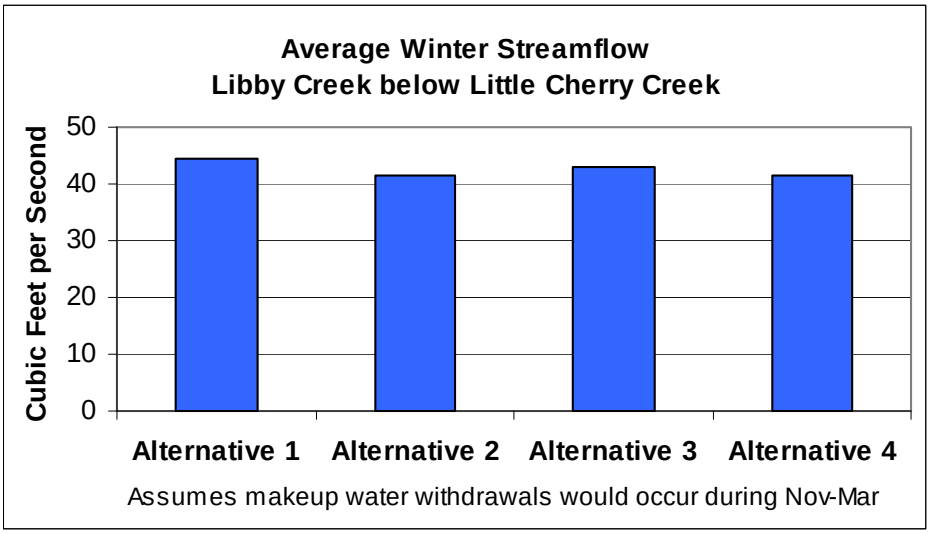
The BHES Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc (both surface and ground water), as well as nitrate (ground water only), and total inorganic nitrogen (surface water only). These nondegradation limits apply to all surface water and ground water affected by the Montanore Project and remain in effect during the operational life of the mine and for as long thereafter as necessary.

In all alternatives, seepage not captured by the seepage collection system would mix with the underlying ground water. The existing ground water quality would be altered because the seepage water quality would have higher concentrations of nutrients, several metals, and total dissolved solids than existing water quality. Manganese concentrations are expected to be higher than the nondegradation limit set in a BHES Order in the mixing zone beneath the impoundment. Concentrations of all other parameters are predicted to be below ground water standards or BHES Order nondegradation limits. Concentrations of total dissolved solids, antimony, and manganese in all alternatives, nitrate in Alternative 2, and zinc in Alternatives 3 and 4 beneath the LAD Areas are predicted to exceed ground water standards or BHES Order nondegradation limits in one or more phases of mining. During the MPDES permitting process, the DEQ would determine if a mixing zone downgradient of the tailings impoundment or LAD Areas would be allowed and, if so, would determine the mixing zone's size, configuration, and location. MMC requested a source-specific mixing zone for the tailings impoundment. The DEQ would determine if a source-specific mixing zone should be granted in accordance with ARM 17.30.518. If DEQ granted a mixing zone, water quality changes may occur and certain water quality standards may be exceeded within the mixing zone. The DEQ also would determine where compliance with applicable standards would be measured.

Ground water beneath the LAD Areas would have higher concentrations of total dissolved solids, nutrients, and metals as long as the seepage collection facilities at the tailings impoundment operates and tailings water is discharged at the LAD Areas. The length of time these closure activities would occur is not known, but may be decades or more.

Surface Water Flows-During Mining. The analysis area is drained on the east by Libby Creek and its tributaries: Ramsey Creek, Poorman Creek, and Little Cherry Creek. Libby Creek flows north from the analysis area to its confluence with the Kootenai River near Libby. The analysis area is drained on the west by the East Fork Rock Creek and East Fork Bull River. The East Fork Rock Creek flows southwest into the Clark Fork River downstream of Noxon Reservoir. The East Fork Bull River flows northwest into the Bull River. The transmission line corridor area is drained by the Fisher River and its tributaries: Hunter Creek, Sedlak Creek, Miller and North Fork Miller creeks, Standard Creek, and West Fisher Creek; and by Libby Creek and its tributaries: Howard Creek, Midas Creek, and Ramsey Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the analysis area. Snowmelt, rainfall, and ground water

discharge are the main sources of supply to streams, lakes, and ponds in the analysis area. High surface water flows typically occur during spring snowmelt, between April and July. Low flows typically occur during August and September.

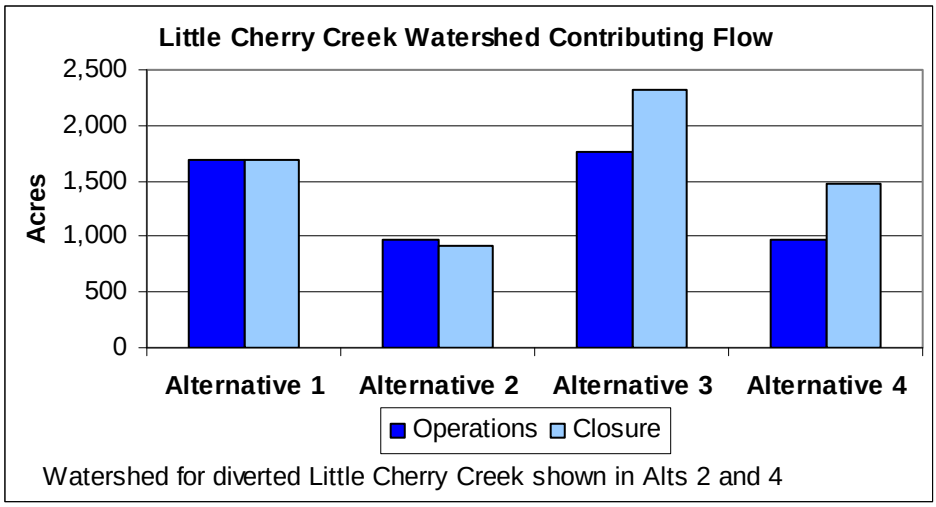


Alternative 1 would not affect surface water flow. All mine alternatives would reduce the flow in area streams during mining. The anticipated changes to base flow have been discussed in the preceding ground water section. Mine facilities would alter flow in Libby Creek and its tributaries through diversions, discharges, and make-up water wells. Changes in flow would not be measurable if withdrawals occur during high flow periods between April and July. In Alternatives 2 and 4, if withdrawals occur during November through March, average flow in Libby Creek below Little Cherry Creek during November through March would be reduced by 6 percent. Average flow in Alternative 3 would be reduced by 4 percent. Percent change in flow would be greater during lower flow periods and less in higher flow periods.

During operations in Alternatives 2 and 4, 13 percent of the Little Cherry Creek watershed would continue to contribute flow to the former Little Cherry Creek channel downstream of the Seepage Collection Dam; the estimated $7Q_{10}$ flow would be 0.01 cubic feet per second (cfs) and the estimated average annual flow would be 0.77 cfs. By intercepting ground water, the pumpback well system below the impoundment may further reduce base flow. The flow in Channel A would be about 60 percent of the flow of the original Little Cherry Creek.

In Alternative 3, any flow within the watershed above the impoundment would be routed to Poorman or Little Cherry creeks. Water from a 146-acre watershed above the Poorman Tailings Impoundment would be diverted to Poorman Creek, increasing the watershed of Poorman Creek by 4 percent. Water from an 80-acre watershed above the Poorman Tailings Impoundment would be diverted to Little Cherry Creek, an increase of 8 percent in the Little Cherry Creek watershed. The larger watershed would increase runoff during stormwater runoff and would not affect base flows.

Surface Water Flows-Post Mining. In Alternative 2, post-mining flows in Libby Creek above Bear Creek would be slightly reduced because surface water runoff from the impoundment would be routed to Bear Creek. The Bear Creek watershed area where runoff would meet the creek would increase by 560 acres, potentially increasing the flow in Bear Creek by 5 percent or less. The larger watershed would increase runoff during stormwater runoff and would not affect base flows.



The Little Cherry Creek Diversion Channel would remain in place, routing surface water runoff in the upper Little Cherry Creek watershed in the Diversion Channel to Libby Creek. After removal of the Seepage Collection Dam, runoff from the South Saddle Dam and the south Main Dam abutment would flow to the Diversion Channel. Runoff from the Main Dam face would flow to the former Little Cherry Creek drainage. Post-mining, 26 percent of the Little Cherry Creek watershed area would continue to contribute flow to former Little Cherry Creek downstream of the Seepage Collection Dam; the estimated $7Q_{10}$ flow of the creek would be about 0.02 cfs and the estimated average annual flow of the creek would be about 1.5 cfs. Average flows in the diverted Little Cherry Creek (Channel A) would be about 55 percent of the flow in the original Little Cherry Creek. For a short segment of Libby Creek between Channel A and Bear Creek, the change in the watershed areas that would contribute water to Libby Creek would be 3 percent or less. Below Bear Creek, flows in Libby Creek would return to pre-mine conditions, less any reduced base flows (predicted by the agencies to be immeasurable).

In Alternative 3, runoff from the reclaimed Poorman Tailings Impoundment surface would be routed toward Little Cherry Creek. The watershed area of Little Cherry Creek would increase by 644 acres, an increase of 38 percent. Average annual flows in Little Cherry Creek would increase by similar percentages. The larger watershed would increase runoff during stormwater runoff and would not affect base flows. Post-mining, changes in the watershed areas contributing water to Poorman and Libby Creek would be 3 percent or less. Below Little Cherry Creek, flows in Libby Creek would return to pre-mine conditions, less any reduced base flows (predicted by the agencies to be immeasurable).

After mining in Alternative 4, runoff from the reclaimed tailings impoundment surface would be routed via the permanent Diversion Channel and Channel A to Libby Creek. After the Seepage Collection Dam was removed, runoff from the South Saddle Dam and the south Main Dam abutment also would flow to the Diversion Channel. Consequently, the watershed of Channel A would increase by about 500 acres post-mining, compared to operational conditions. Average annual flow in the diverted Little Cherry Creek would be about five times the existing flow in Channel A, but about 10 percent less than the current flow of Little Cherry Creek. The larger watershed would increase runoff during stormwater runoff and would not affect base flows.

Runoff from the Main Dam would flow to the former Little Cherry Creek channel. Post-mining, the watershed area contributing water to the former Little Cherry Creek channel would decrease by 85 percent directly below the tailings impoundment and by 74 percent at the confluence of Little Cherry and Libby creeks. Changes in the watershed areas contributing flow to Bear and

Libby creeks would be 5 percent or less. Below Bear Creek, flows in Libby Creek would return to pre-mine conditions, less any reduced base flows (predicted by the agencies to be immeasurable). Bear Creek streamflow would not be affected.

Surface Water Quality. Water quality in analysis area streams is generally good. Total suspended solids, TDS, major ions, and nutrient concentrations are all low, frequently at or below analytical detection limits. Generally, TDS, major ion, and some minor ion concentrations (such as iron) increase downstream in Libby Creek and its tributaries. Some elevated metal concentrations can be attributed to local geology (mineralization).

In the analysis area, three stream segments are listed on Montana's 303(d) list of impaired streams. Libby Creek from 1 mile above Howard Creek to the U.S. 2 Bridge is listed. Use as a drinking water supply is not supported as a beneficial use, and aquatic life support and cold-water fishery uses are only partially supported for this reach. The Fisher River from the confluence of the Silver Butte Fisher River and the Pleasant Valley Fisher River to the confluence with the Kootenai River is also listed, with aquatic life support and cold-water fishery uses only partially supported. Rock Creek from the headwaters to the mouth below Noxon Dam is also listed, with aquatic life support and cold-water fishery uses only partially supported. Total Maximum Daily Loads (TMDLs) for the impairments have not been prepared by the DEQ.

Alternative 1 would not affect surface water quality. Alternatives 2, 3, and 4 would affect stream quality by changing dissolved solids, nutrients, and metals concentrations. Changes would occur in part due to reductions in streamflow contributions from deeper ground water, which contributes more total dissolved solids to streams than shallower sources of water. Water quality changes also would occur due to wastewater discharges at the LAD Areas. The agencies' analysis indicated that concentrations of total inorganic nitrogen and manganese in Ramsey and Poorman creeks may exceed BHES Order limits in all alternatives during one or more phases of mining. Antimony and zinc concentrations may also exceed surface water standards or BHES Order limits. With proposed treatment, instream concentrations following discharges would be at or below concentrations set in the BHES Order, surface water quality standards, or ambient concentrations. If land application of excess water would result in water quality exceedances, MMC would treat the water at the Libby Adit Water Treatment Plant prior to land application. If needed, an additional water treatment facility may be required. Water discharged from the treatment facilities to a nearby stream could not cause an exceedance in a BHES Order nondegradation limit or water quality standard for all parameters. Concentrations of total inorganic nitrogen in streams affected by the Montanore Project may increase to 1 mg/L, copper to 0.003 mg/L, and manganese to 0.05 mg/L, the limits set in the BHES Order.

Surface Water Quality-Sediment. In Alternatives B, C, and D, areas cleared of vegetation would be susceptible to erosive forces and soil loss. Loss of soil also would occur from the removal and storage of soils during mine operations and from erosion of exposed soils during reclamation and stabilization. Soil erosion caused by wind or water likely would occur during all phases of the project. Initial erosion rates would be moderate to high due to soil exposure, slope steepness, and precipitation patterns.

In Alternative 2, MMC proposed a 10,800-foot Little Cherry Creek Diversion Channel around the tailings impoundment that would flow into Libby Creek. The Diversion Channel would consist of two main sections: an upper engineered channel and two existing natural drainage channels tributary to Libby Creek. The lower channels are not large enough to handle the expected flow

volumes; these tributaries would undergo channel adjustments until they stabilized. These adjustments would include bank erosion, channel scouring, and sloughing of bank material, which would contribute sediment to Libby Creek. MMC would construct some bioengineering and structural features in the two unnamed tributary channels to reduce flow velocities, minimize erosion in the unnamed tributaries, minimize sedimentation to Libby Creek, and create fish habitat. In addition, MMC would evaluate potential locations for creating wetlands and ponds in low gradient areas to capture and retain most of the sediment generated from the unnamed tributaries and minimize sedimentation to Libby Creek. Bank erosion in the unnamed tributaries and possibly sedimentation to Libby Creek would continue until the tributaries adjusted to the increased flow volumes. If substantial erosion occurs once the diversion channel was operational, additional erosion control structures would be constructed as needed.

One of the possible fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. If implemented, this project would minimize the contribution of additional sediment to the Libby Creek watershed.

Alternative 4 would have similar effects as Alternative 2. The Diversion Channel in Alternative 4 would flow into a constructed channel that would be designed to be geomorphologically stable and to handle the 2-year flow event. A floodplain would be constructed along the channel to allow passage of the 100-year flow. Natural and biodegradable materials and vegetation would be used along stream banks and on the floodplain to minimize erosion, stabilize the stream channel and floodplain, and minimize sedimentation to the lower channel and Libby Creek. Following reclamation of the impoundment, the constructed channel would undergo an additional period of channel adjustment when runoff from the impoundment surface was directed to the Diversion Channel. The increase in flow would be about 50 percent higher than during operations, and would lead to new channel adjustments. This would likely cause short-term increases in sedimentation in the lower channel and Libby Creek.

Alternative 3 would result in less sedimentation of analysis area streams than Alternatives 2 or 4 because diversion of a perennial stream would not be needed. Effects of vegetation clearing for mine facilities and access roads would be similar to Alternatives 2 and 4.

In Alternatives 3 and 4, MMC would initially identify existing sediment sources in Libby Creek particularly near the plant site and then off-site in Ramsey, Poorman, or upper Libby creeks. After existing sediment sources were identified, MMC would develop sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sources. This mitigation would minimize the contribution of additional sediment to the Libby Creek watershed.

Issue 3: Fish and Other Aquatic Life and Their Habitats

Aquatic habitat in most analysis area streams is good to excellent. The riparian habitat condition in Libby Creek between Poorman Creek and Little Cherry Creek is fair, reflecting the physical effects of abandoned placer mining operations. Overall, the analysis area streams score high on measures such as bank cover and stability, while measures of pool quality and quantity are typically lower, resulting in an overall reduction in stream reach scores for habitat condition. Most streams have a moderate susceptibility to habitat degradation.

Analysis area streams provide habitat for the federally listed bull trout, and Forest sensitive species westslope cutthroat trout and interior redband trout. Mixed redband rainbow, coastal rainbow, and westslope cutthroat/rainbow hybrids, Yellowstone cutthroat, brook trout, torrent and slimy sculpin, mountain whitefish, longnose dace, and largescale suckers are also in the drainages. In the mine analysis area, designated critical bull trout habitat is found in four segments of Rock Creek and three segments of Libby Creek. Bull trout are found in most streams, except where barriers have prevented their passage, such as Little Cherry Creek and Miller Creek. No pure westslope cutthroat trout populations have been found to inhabit stream reaches within the Libby Creek watershed. The hybrid trout populations in Ramsey Creek, Bear Creek, Little Cherry Creek, and segments of Libby Creek downstream of the mine area include coastal rainbow/westslope cutthroat and redband/westslope cutthroat trout hybrids. The East Fork Bull River has a pure westslope cutthroat trout population, and both pure and hybrid populations are found in East Fork Rock Creek. Miller Creek has a pure westslope cutthroat trout population. Pure populations of interior redband trout are found in Libby, Bear, Little Cherry Creek, Poorman, and Ramsey creeks and in the Fisher River.

In Alternative 1, No Mine, the Montanore Project would not be developed and existing disturbances would continue to affect aquatic habitats. Past activities, particularly timber harvest and road construction, and ongoing current activities have occurred in RHCAs, and would continue to decrease the quality of aquatic habitats. Productivity of fish and other aquatic life in analysis area streams would continue to be limited by past natural and human-caused adverse habitat changes, by naturally low nutrient concentrations, and by natural habitat limitations from periodic floods and other climate and geology influences.

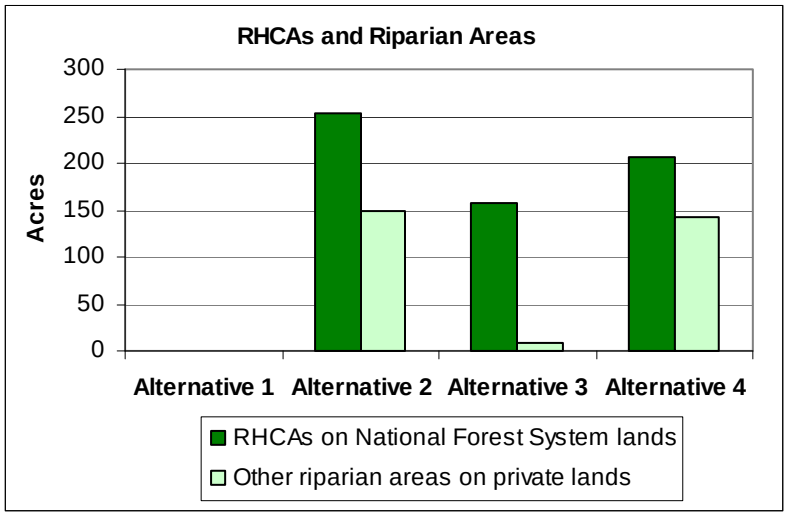
Bull trout populations would continue to be marginal and their habitat would continue to be in need of restoration work. Bull trout populations would be susceptible to decline or disappearance due to hybridization with the introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances. Redband trout and westslope cutthroat trout also would continue to be subject to population declines, mainly due to the threat of hybridization from past introductions of non-native salmonids.

Sediment. Periodic short-term increases in the amount of sediment would occur in streams in the Libby Creek watershed in Alternatives 2, 3, and 4. An increase in the amount of sediment in streams can alter stream habitat by decreasing pool depth, affecting substrate composition, filling in interstitial spaces used by juvenile fish and invertebrates, and increasing substrate embeddedness. These habitat alterations in turn can adversely affect the invertebrate and fish populations within the streams. The abundance of fine sediment does not currently appear to be a limiting factor to trout populations within most stream reaches within the Libby Creek watershed. Competition with brook trout and other trout species is one of the larger threats to bull trout in the Libby Creek drainage, and there are indications that brook trout are more successful than native trout in degraded areas, including areas where fine sediment levels are increased. Slight increases in sediment in Libby Creek may give the brook trout present in this stream a competitive advantage over bull trout. The introduction of small amounts of additional small gravels and fine sediment from construction or operation of the mine would likely have few effects on macroinvertebrate and fish populations, and these effects would be short-term, as annual snowmelt runoff would flush most accumulated fine sediments downstream. The optional mitigation in Alternative 2 and the required mitigation in Alternatives 3 and 4 includes an inventory of existing sediment sources in the Libby Creek watershed and the implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution

from the identified sources. Alternatives 3 and 4 also would include the installation of grade control structures in a reach of Libby Creek between Little Cherry Creek and Bear Creek to decrease the width to depth ratio and increase the frequency of deep pool habitat. Grade control structures would improve bedload transport, decrease width to depth ratios, and reduce fine sediment accumulation.

Riparian Habitat Conservation Areas. RHCAs are protection zones adjacent to streams, wetlands, and landslide-prone areas. The KFP has standards and guidelines for managing activities that potentially affect conditions within the RHCAs, and for activities in areas outside RHCAs that potentially degrade RHCAs. These standards apply only to riparian areas on National Forest System lands. Similar riparian areas are found on private land. All riparian areas are covered by Montana's Streamside Management Zone law.

Alternatives 2, 3, and 4 would require construction of roads, waste disposal facilities, and other facilities in RHCAs. Protection of RHCAs was a key criterion in the alternatives analysis and development of alternatives. The lead agencies did not identify a practicable alternative that would avoid locating mine facilities in RHCAs. Alternative 2 would affect 253 acres of RHCAs and 148 acres of other riparian areas on private lands, primarily in the Little Cherry Creek Impoundment Site and the Ramsey Plant Site. Little Cherry Creek and Ramsey Creek are both fish-bearing streams. Effects of Alternatives 3 and 4 would be less than Alternative 2. Alternative 3 would affect 158 acres of RHCAs and 9 acres of other riparian areas on private lands. The RHCAs in the Poorman Tailings Impoundment Site in Alternative 3 are not adjacent to fish-bearing streams. The Libby Plant Site in Alternatives 3 and 4 would not affect RHCAs. The disturbance area at the Little Cherry Creek Impoundment Site would be changed in Alternative 4 to avoid RHCAs. Alternative 4 would affect 206 acres of RHCAs and 143 acres of other riparian areas on private lands, primarily in the Little Cherry Creek Impoundment Site. In Alternatives 3 and 4, MMC would develop and implement a final Road Management Plan to reduce effects on RHCAs. The plan would describe for all new and reconstructed roads criteria that govern road operation, maintenance, and management; requirements of pre-, during-, and post-storm inspection and maintenance; regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives; implementation and effectiveness monitoring plans for road stability, drainage, and erosion control; and mitigation plans for road failures.



Water Quantity. During operations, Alternatives 2, 3, and 4 would alter flow in Libby Creek and its tributaries through diversions, discharges and make-up water wells. Changes in flow would not be measurable if withdrawals occur during high flow periods between April and July. If withdrawals occur during November through March, average flow in Libby Creek below Little Cherry Creek would be reduced by 4 to 6 percent, depending on the amount of mine inflows and

the alternative. Percent change in flow would be greater during lower flow periods and less in higher flow periods. The inherent difficulties in accurately measuring low flows and the natural variability in low winter flow make the determination of impacts to fish habitat very difficult, but the decrease in flow would decrease available habitat. Except for Little Cherry Creek, changes in flow in Libby Creek tributaries would not affect aquatic life. Post-closure, a slight decrease in Libby Creek streamflow may decrease available habitat slightly during low flow periods, adversely affecting salmonids in the stream. During the post-mining period, water would continue to be released from tailings consolidation and discharged at the LAD Areas. Discharges at the LAD Areas would continue to increase Libby Creek streamflows. This additional flow in Libby Creek below the LAD Areas would partially offset the reduction in base flow when discharges occurred. Aquatic habitat would not be affected as long as discharges continue. The installation of 25 structures in Libby Creek in Alternatives 3 and 4 would offset the reduction of fish habitat in the creek.

In Alternatives 2 and 4, Little Cherry Creek would be diverted permanently around the tailings impoundment, resulting in a loss of 13,000 feet of aquatic habitat in the existing Little Cherry Creek. The diverted Little Cherry Creek would be shorter (9,500 feet) and consequently steeper. In Alternative 2, average flow in the diverted Little Cherry Creek during operations would be about 60 percent of the average flow in the existing Little Cherry Creek, and about 55 percent after closure. Alternative 4 would have similar effects on flow during operations. After closure, flow in the diverted Little Cherry Creek in Alternative 4 would be about 90 percent of the average flow in the existing Little Cherry Creek because flow from the impoundment surface would flow to the diverted creek and not to Bear Creek. The agencies' analysis assumed the engineered diversion channel would not provide any fish habitat, while the two channels would eventually provide marginal fish habitat for either redband trout or bull trout. Effects on the redband trout population in Little Cherry Creek would be minimal but would persist long-term.

In both alternatives, MMC would collect all fish in the existing stream section and move the fish to the newly constructed diversion channel. While MMC would remove redband trout safely from the section of Little Cherry Creek to be diverted and then place them in the new diversion drainage, some fish mortality due to handling stress may occur from removal, storage, or replacement methods. MMC would design the Little Cherry Creek Diversion Channel, to the extent practicable, for fish habitat and passage. MMC's survey of the unnamed tributary to Libby Creek that would receive diverted water (Channel A) shows that most of the drainage would develop habitat comparable to Little Cherry Creek.

During operations, Alternatives 2, 3, and 4 would reduce flow in East Fork Rock Creek and East Fork Bull River. These flow changes would affect aquatic habitat in the East Fork Rock Creek between Rock Lake and Rock Creek Meadows, a distance of about 0.75 mile. Trout habitat may be reduced during low flows from August to April. This habitat loss would be detrimental to the resident westslope cutthroat trout populations in the higher elevations of East Fork Rock Creek. Changes in flow from Rock Creek Meadows downstream would not likely be measurable, but would contribute to the dewatered sections and lower habitat in lower Rock Creek. Changes in flow in the East Fork Bull River below St. Paul Lake during mine operations may be difficult to separate from the natural variability of low flows. Flow reductions in the upper river may result in habitat loss and adversely affect the bull trout population that spawns in East Fork Bull River.

For fisheries mitigation in Alternatives 3 and 4. MMC would complete a comprehensive aquatic habitat assessment from the confluence of the East Fork Bull River and Snake Creek up to the

extent of fish habitat in the East Fork Bull River (~1.3 miles past the CMW boundary). Following completion of the habitat inventory, MMC would construct instream structures forming pools and deep water habitat (>1.5 feet depth) from Snake Creek to a location 0.5 mile into the CMW. Trail #935 leading to Rock Lake would be converted from a motorized trail to a non-motorized trail, reducing its sediment contribution and increasing riparian habitat along the trail. These measures would improve aquatic habitat in Rock Creek and the East Fork Bull River.

Water Quality. Alternatives 2, 3, and 4 would increase concentrations of nutrients, such as nitrates, and some metals in Ramsey, Poorman, and Libby creeks. Presently, low nutrient concentrations contribute to the naturally limited aquatic productivity. If the total organic nitrogen concentration in Libby Creek surface water increases to the allowable concentration of 1 mg/L set in the BHES Order, this would be an increase over existing concentrations in Libby Creek by a factor of 2 to 5. Increases in total organic nitrogen concentrations to 1 mg/L would be more likely near the discharge areas (LAD Areas and the Libby Adit), as total organic nitrogen concentrations would decrease downstream due to dilution with higher streamflows. The total organic nitrogen concentration increase may cause an increase in algal growth in Libby Creek, but algal growth would more likely be limited by factors other than nitrogen, such as phosphorus, temperature, flow, and light. Although the projected total organic nitrogen concentration would be greater than existing conditions, the ammonia component of total organic nitrogen would remain well below the applicable standard.

The BHES Order would allow an increase of copper up to 0.003 mg/L in all project waters. About half the surface water samples from Libby Creek had copper concentrations below the detection limit, 15 percent were greater than 0.003 mg/L, and the remaining samples were 0.003 mg/L or less. The enrichment for copper may increase up to a factor of 3 or more, depending on the actual copper concentration of samples with below detection limit values, and the actual instream copper concentration after discharge of wastewater. Potential effects to aquatic life from an increase in copper concentrations are difficult to determine given the uncertainty with the protectiveness of the hardness-modified copper standard and existing copper concentrations. Measured copper concentrations are either at or near minimum laboratory detection limits, creating some uncertainty with the projected change in concentrations from existing conditions.

Issue 4: Scenic Quality

The existing scenery from Key Observation Points (KOPs) would not change in the No Mine Alternative. The existing Libby Adit Site would remain, and would be visible only from one KOP in a montane forest at a National Forest System road #231 pullout. Disturbances on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals.

Construction of all proposed mine facilities would alter the scenic integrity from KOPs. The relatively large size of the tailings impoundment in Alternatives 2, 3, and 4 in all views would create noticeable contrasts in landscape character and significant alterations in scenic integrity. The tailings impoundment in Alternatives 2 and 4 would cover Little Cherry Creek, altering the area’s scenic integrity. In addition, there would be the short-term effects from the presence of fugitive dust from construction activities, night lighting for construction operations, and vehicle traffic. The agencies’ mitigations in Alternatives 3 and 4 would reduce the visual contrasts at most facility locations. Long-term effects on scenery would be loss of vegetation and landform changes at all mine facilities. Following mine closure, landscape reclamation at all mine facilities, except

the tailings impoundment, would create areas similar in appearance to abandoned roads and timber harvest areas. The tailings impoundment would have physical characteristics significantly contrasting with the surrounding landscape. The scenic integrity and landscape character changes at the impoundment site would be noticeable indefinitely.

In Alternatives 2, 3, and 4, the KNF would amend the KFP by reallocating to MA 31 all areas within the operating permit areas of LAD Areas 1 and 2, and portions of the plant site and tailings impoundment currently not in MA 31. In addition, a proposed road and facility corridor that would cross MA 13 would be reallocated to MA 31. MA 31 has a Visual Quality Objective (VQO) of Maximum Modification. All mine facilities would be in compliance with a VQO of Maximum Modification.

Issue 5: Threatened and Endangered Wildlife Species

The mine area provides habitat for three threatened and endangered wildlife species: the grizzly bear, the gray wolf, and the Canada lynx. This summary provides a brief discussion of effects on threatened and endangered wildlife species; the reader is referred to section 3.24.5, *Threatened, Endangered, and Proposed Species* in the *Wildlife Resources* of Chapter 3 for a complete analysis of effects on threatened and endangered wildlife species. Bull trout, which is also a threatened and endangered species, was discussed previously under Issue 3, Effects on Fish and Other Aquatic Life and Their Habitats.

Grizzly Bear. The agencies used five criteria to assess effects on the grizzly bear: percent core habitat, percent open motorized route density (OMRD), percent total motorized route density, linear open road density, and percent habitat effectiveness (HE). Because percent OMRD, percent total motorized route density, and linear open road density are all a function of open roads, only percent OMRD is discussed in this Summary.

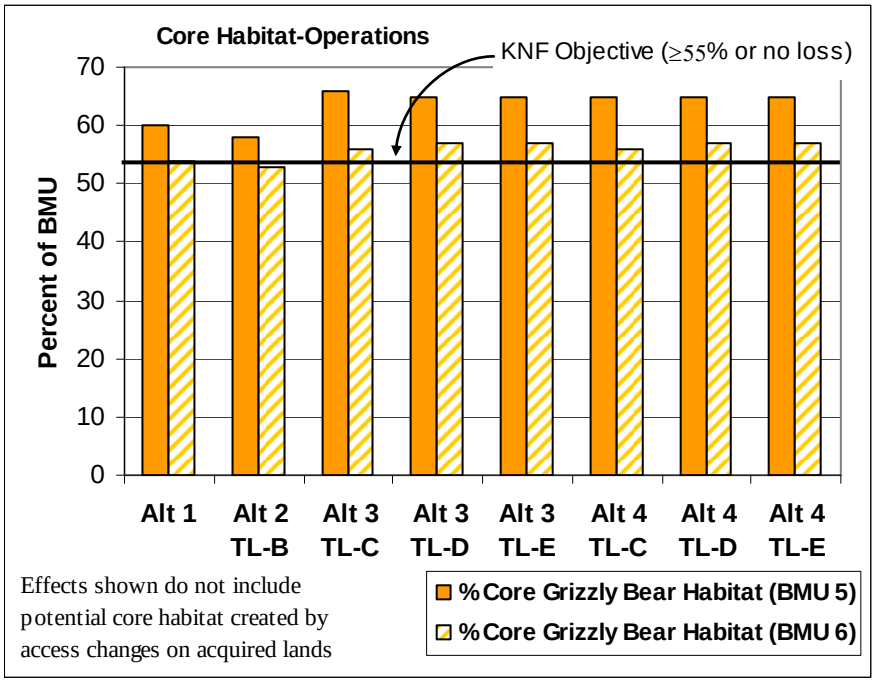
These criteria are evaluated within a planning area called a Bear Management Unit, or BMU. A BMU is an area of land containing sufficient quantity and quality of all seasonal habitat components to support a female grizzly. The project would affect habitat in two BMUs: BMU 5, St. Paul, and BMU 6, Wanless.

Because of the complexity of the analysis, the agencies did not complete separate analyses for criteria dependent on open roads for the mine alternatives and transmission line alternatives. Instead, the agencies analyzed combinations of mine and transmission line alternatives, which would compose a complete project. Alternative 2-TL B is MMC's proposed mine (Alternative 2) and its proposed North Miller Creek transmission line alternative (Alternative B). Six other mine and transmission line alternative combinations were analyzed: mine Alternative 3 with the three agencies' transmission line alternatives (Alternatives C, D, and E); and mine Alternative 4 with the three agencies' transmission line alternatives (Alternatives C, D, and E). These combinations are discussed in the following sections on effects to grizzly bear.

Percent Core Habitat. A core area or core habitat is an area of high quality grizzly bear habitat within a BMU that is greater than or equal to 0.31 mile from any road (open or restricted), or motorized trail open during the active bear season. Core habitat may contain restricted roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth. Federal agencies will work toward attaining a core area of at least 55 percent in the BMU and will allow no loss of core areas on federally-owned land within the BMU.

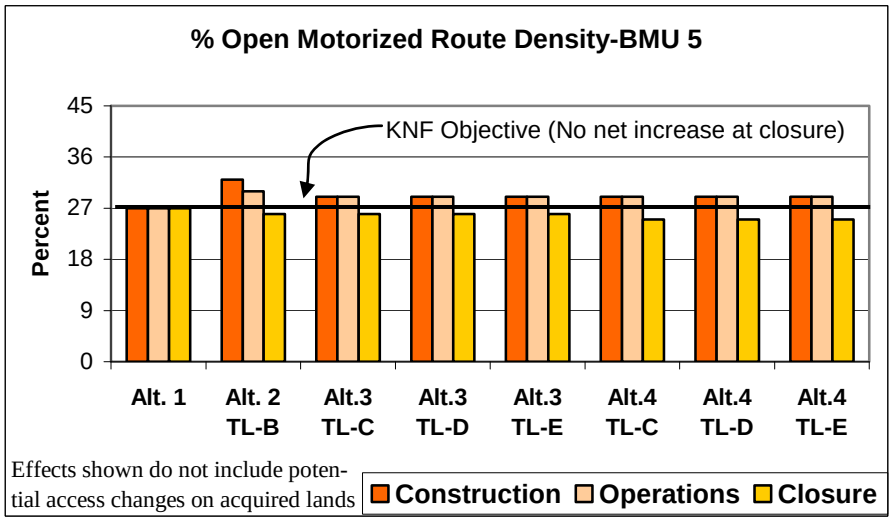
Alternative 2 TL-B would reduce core habitat from 60 percent in BMU 5 to 58 percent during construction and operations, and to 59 percent at closure. Access changes proposed by the KNF would create core habitat in the agencies' alternatives, and core habitat in the other six alternative combinations would increase to 65 or 66 percent during construction, operations, and closure.

Core habitat in BMU 6 (54 percent) currently is below the goal of 55 percent and would remain so in Alternative 1. During construction, operations, and closure, Alternative 2-TL B would reduce core habitat from 54 percent in BMU 6 to 53 percent. Core would increase through access changes to between 55 and 57 percent in all other alternative combinations during all three periods.

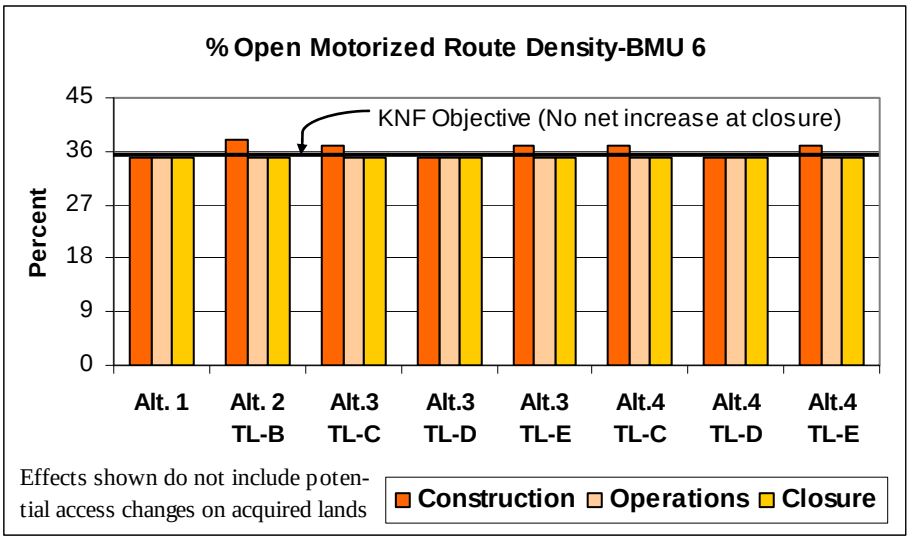


For all combined mine-transmission line alternatives, impacts to core habitat would be reduced through MMC's or the agencies' proposed land acquisition programs. Parcels that might otherwise be developed in a manner inconsistent with bear needs would be acquired by MMC, conveyed to the KNF, and managed for grizzly bear use in perpetuity. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' proposed land acquisition program has the potential to increase core habitat through access changes on acquired land. The potential increase in core habitat from acquired lands is not shown in the above chart.

Open Motorized Route Density. OMRD is a measure of the density of roads or trails in a BMU that are open for motorized access. Best science indicates that OMRD greater than 1 mi/mi^2 should not exceed



33 percent of a BMU. Federal agencies will allow no net increase in OMRD on federally-owned land within the BMU.



All combined alternatives would increase OMRD in BMU 5 during construction and operations. OMRD in BMU 5 would be better than existing densities after closure for all Alternatives. Compliance with OMRD direction is based on densities at mine closure.

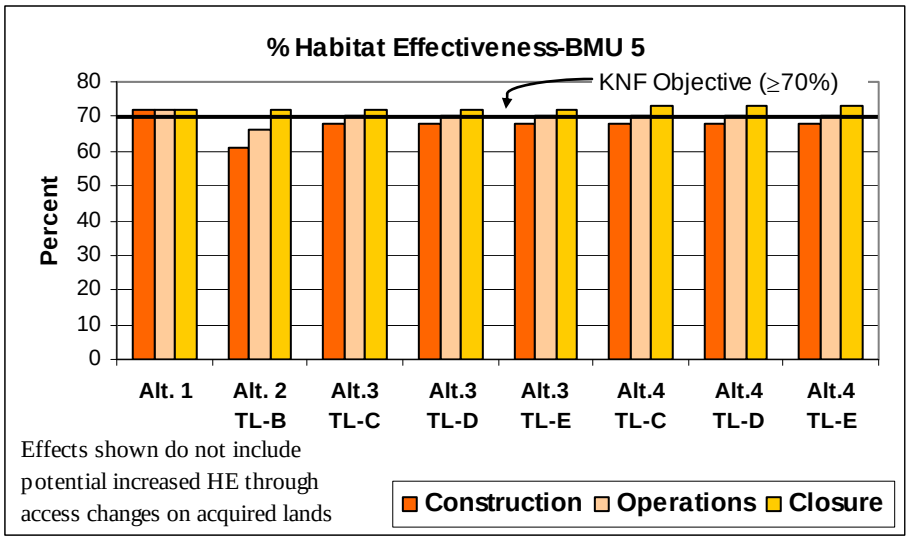
OMRD in BMU 6 during construction would be worse than existing densities in all combined alternatives, and would return to existing densities during operations and after closure for all combined alternatives. The agencies' proposed land acquisition program has the potential to improve OMRD in BMUs 5 and 6 through access changes on acquired land.

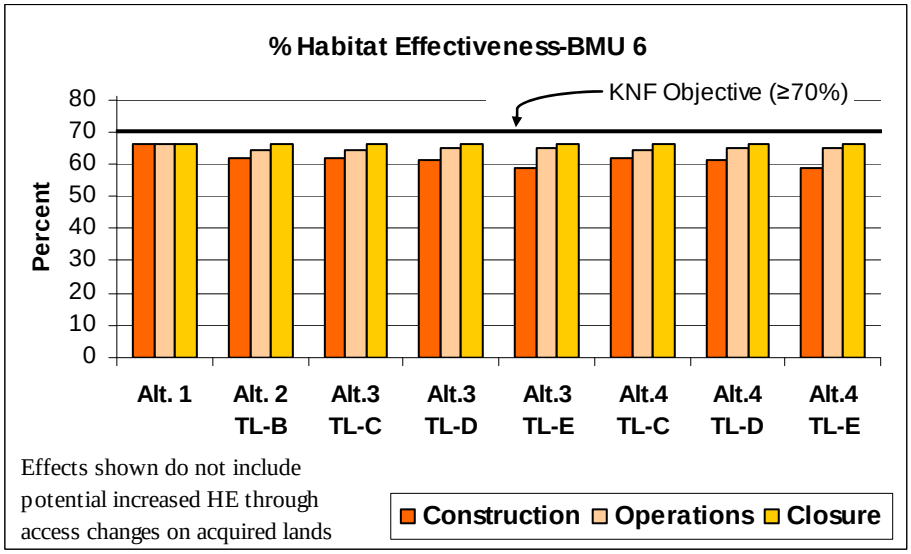
Habitat Effectiveness. HE is the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity during the active bear year) remaining within a BMU after affected areas and Management Situation 3 lands (where grizzly bear presence is possible but infrequent) are subtracted from the total habitat in the BMU. Management Situation 3 lands are areas of high human use where grizzly bear presence is possible but infrequent and where conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged.

HE is calculated for all lands within an affected BMU, regardless of ownership. In calculating HE, the extent of a zone of influence depends on the type of activity. HE should be maintained equal to or greater than 70 percent of the BMU.

For all combined mine-transmission line alternatives, impacts to HE during all three phases would be reduced through MMC's (Alternatives 2 and B) and the agencies' proposed land acquisition programs (all other alternatives). Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' proposed land acquisition program would likely result in a net gain in grizzly bear habitat effectiveness, through access changes and elimination of sources of grizzly bear disturbance, where possible. Potential increased HE through land acquisition is not shown in the charts or discussed in the following paragraphs.

Alternative 2 TL-B would have greater effect to HE in BMU 5 than the other alternatives, reducing HE to 61 percent during construction and 66 percent during operations, primarily because effects of the Ramsey Plant Site would occur in a separate drainage than other mine facilities. The combined agencies' alternatives would have the same effects on HE in BMU 5, reducing HE to 68 percent during construction and 70 percent during operations. At closure, HE would be 72 to 73 percent in all combined alternatives.





In BMU 6, Alternatives 3 TL-E and 4 TL-E would reduce HE to 59 percent during construction, due to a larger extent of helicopter activity. The other combined alternatives would reduce HE in BMU 6 to 61 or 62 percent during construction. During operations, all alternatives would be similar, reducing HE to 64 or 65 percent. At closure, HE would return to 66 percent in all combined alternatives.

Gray Wolf. The agencies evaluated impacts to the gray wolf based on three criteria: year-round prey base, suitable denning and rendezvous sites, and sufficient space with minimal exposure to humans. The condition of the prey base is evaluated based on KFP management standards for white-tailed deer and elk. Sufficient space with minimal exposure to humans is generally measured by maintaining ORD standards required by the KFP as well as maintaining any security habitat recommended in the big game habitat recommendations. The Fishtrap pack is the only known wolf pack potentially affected by the Montanore Project. At least two wolves use portions

of the analysis area on a regular basis. No wolf packs or den sites have been confirmed in this general area.

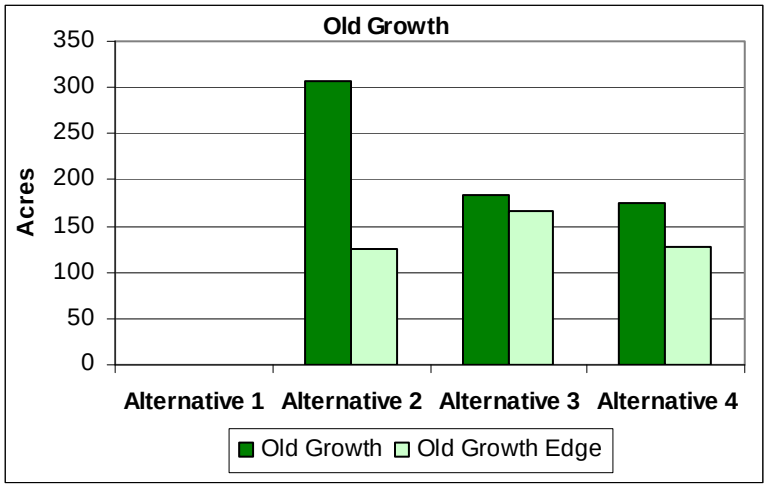
Alternative 1 would not affect the gray wolf and would not change existing conditions for prey base, denning and rendezvous sites, or space with minimal exposure to humans. For all mine alternatives, sufficient populations of elk, deer and other prey species would continue to be maintained, and would continue to provide a good year-round prey base for wolves, and no known den or rendezvous sites would be affected by any of the mine alternatives. All mine alternatives would increase road densities, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality. Road densities would increase more for Alternative 2 in the Crazy Planning Subunit, and would remain worse than existing densities until after mine closure.

For all alternatives, impacts to the gray wolf would be reduced through MMC's or the agencies' proposed land acquisition programs. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. For the agencies' alternatives, potential impacts to wolves also would be minimized through road access changes that would create security habitat for prey species and reduce motorized access of wolf habitat, prohibiting employees to carry firearms, removing road-killed big game animals, implementing a transportation plan to reduce mine traffic, and monitoring road-killed animals. Overall, all mine alternatives would have a minimal effect on the gray wolf.

Canada Lynx. The impacts analysis for the Canada lynx follows the objectives, standards, and guidelines established in the Northern Rockies Lynx Management Direction (Lynx Amendment). Standards are evaluated for Lynx Analysis Units (LAUs) that approximate a lynx home range size. Alternatives B, C, and D would comply with Lynx Amendment standards with the following exception. All mine alternatives would affect multi-story or late-successional forest snowshoe hare (lynx denning) habitat and would not meet this standard. Impacts to multi-story or late-successional forest snowshoe hare habitat from mine alternatives would occur only in LAU 14504, and would range from 167 acres for Alternative 3 to 391 acres for Alternative 2.

Issue 6: Other Wildlife and Key Habitats

Old Growth. Alternative 1 would have no direct effect on designated old growth or associated plant and wildlife. All old growth areas would maintain their existing conditions and continue to provide habitat for those species that use the area over a long term. Alternatives 2, 3, and 4 would reduce the amount of old growth in the Crazy Planning Subunit. Old growth removed for mine facilities would range from 175 acres in Alternative 4 to 307 acres in Alternative 2. Alternatives 2, 3, and 4 would reduce the quality of old growth by creating openings in old growth, or



creating an “edge effect.” Edge effects would range from 125 acres in Alternatives 2 and 4, to 167 acres in Alternative 3.

Mine Alternatives 2, 3, and 4 would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Designated Old Growth) designation of all harvested stands to MA 31 (Mineral Development). In Alternatives 3 and 4, the KNF would designate 587 acres in Alternative 3 and 657 acres in Alternative 4 of additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. Losses and degradation of old growth habitat may be offset by land acquisition associated with grizzly bear habitat mitigation if old growth habitat characteristics were present on the acquired parcels. Sufficient designated old growth would be present below 5,500 feet in all alternatives to be consistent with the KFP direction regarding old growth.

Pileated Woodpecker. In Alternative 1, natural successional processes would continue to occur throughout old growth stands and habitat would continue to be provided for pileated woodpecker nesting pairs where feeding and breeding conditions are suitable. There would be no direct or indirect impacts to pileated woodpecker (old growth habitat) from Alternative 1, and no change in potential population index. The effects on old growth in Alternatives 2, 3, and 4 would reduce nesting and foraging habitat and habitat quality for the pileated woodpecker. The potential population index in Alternatives 2, 3, and 4 would not be affected. Alternatives 2, 3, and 4 would result in the loss of snags and downed logs greater than 10 inches diameter at breast height that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain above KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF.

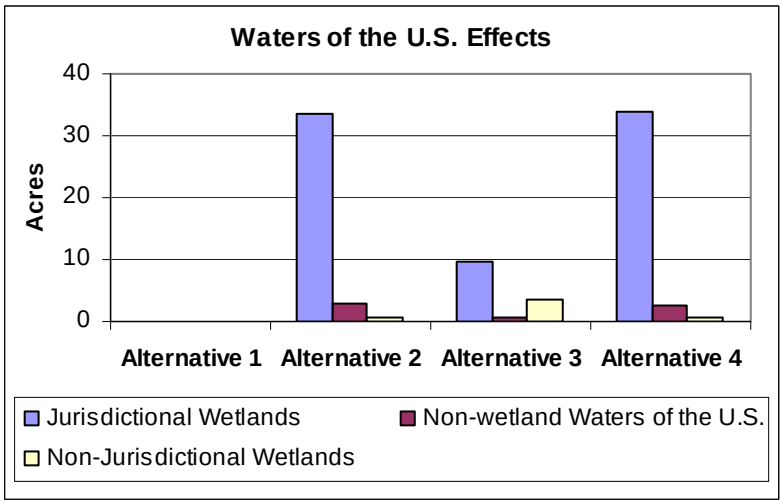
Issue 7: Wetlands and Non-Wetland Waters of the U.S.

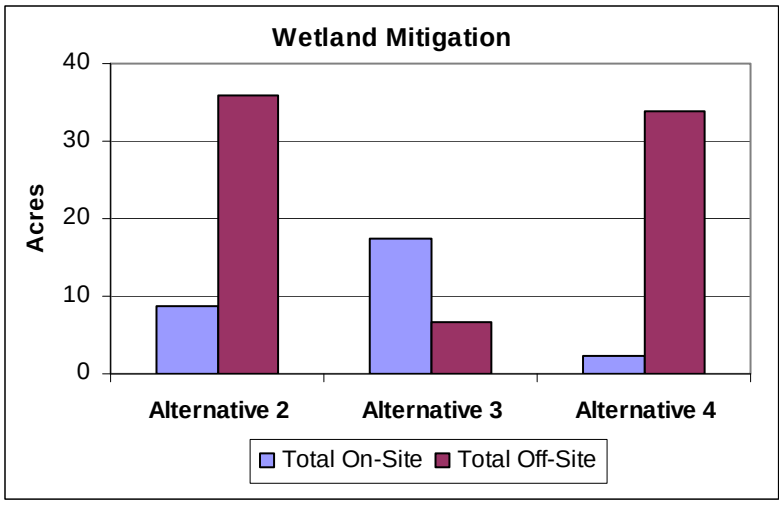
The No Mine Alternative would not disturb or affect any wetlands or waters of the U.S. Any existing wetland disturbances would be mitigated in accordance with existing permits and approvals.

Alternatives 2, 3, and 4 would require the unavoidable filling of jurisdictional wetlands, non-jurisdictional wetlands, and other waters of the U.S. The Corps determines a water to be subject to its jurisdiction if the water body is a traditionally navigable water, relatively permanent, or a wetland that directly abuts a traditionally navigable or relatively permanent water body, or, in combination with all wetlands adjacent to that water body, has a significant nexus with traditionally navigable waters. All waters of the U.S. as well as activities that require the discharge of fill material into wetlands or waters of the U.S. are regulated by the Corps. Based on a Supreme Court 2001 ruling, wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, do not fall under Corps’ jurisdiction. The terms “isolated” and “non-jurisdictional” wetlands are used synonymously.

Effects of Alternatives 2 and 4 would be similar, affecting 34 acres of jurisdictional wetlands, about 1 acre of non-jurisdictional wetlands, and about 3 acres of other waters of the U.S. Alternative 3 would have less effect than Alternatives 2 and 4. Alternative 3 would affect 9.7 acres of jurisdictional wetlands, 3.4 acres of non-jurisdictional wetlands, and less than 1 acre of other waters of the U.S. In all alternatives, mitigation measures for wildlife and fisheries include

activities in waters of the U.S. Any wetlands and waters of the U.S. disturbed during the implementation of these measures are not accounted for in the acreage listed above. In the short term, these activities would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. After the activities were completed, and the roads became stabilized, these mitigation measures would increase the function and values of any associated wetlands and would decrease sediment delivery to waters of the U.S.





MMC proposes to replace forested and herbaceous wetlands at a 2:1 ratio and herbaceous/shrub wetlands at a 1:1 ratio. On-site mitigation opportunities would involve wetland restoration and wetland creation. A total of 8.8 acres of on-site mitigation is proposed for Alternative 2. Off-site mitigation would occur outside the permit area boundary. A total of 35.8 acres of off-site mitigation would mitigate for effects associated with Alternative 2. Most mitigation sites would be located in the Poorman Creek area. The Corps would be responsible for developing final mitigation ratios, depending on the function and values of the affected wetlands. Replacing herbaceous/shrub wetlands at a 1:1 ratio would not meet the minimum Corps mitigation ratio. Annual monitoring of mitigation sites would ensure mitigation sites were dominated by appropriate vegetation and had comparable function and value to the affected wetlands.

In Alternatives 3 and 4, jurisdictional wetlands would be replaced at a ratio described in Alternative 2 while non-jurisdictional wetlands would be replaced at a 1:1 ratio. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas. Sufficient mitigation sites have been identified for Alternative 3 to achieve the Corps' minimum ratios. Mitigation sites identified for Alternative 4 are insufficient to achieve the Corps' minimum ratios, and additional mitigation sites would be necessary if this alternative were permitted.

The effect on wetland, spring, and seep habitat overlying the mine would be the same in Alternatives B, C, and D. The effect on wetlands, springs, and seeps overlying the mine and

downstream of the tailings impoundment is difficult to predict. The effect on plant species, functions, and values associated with the affected wetlands, springs, or seeps by a change in water level would be best determined by relating plant species with water abundance and quality for monitoring and evaluation. Alternative 2 does not include a survey of plant species abundance (all species) prior to activity and subsequent plant species abundance and water monitoring of ground water-dependent ecosystems overlying the mine. Without this type of monitoring, mining-induced changes in water level or quality may result in a loss of species, functions, and values associated with the affected wetlands, springs, or seeps. Additional monitoring of wetlands, springs, and seeps overlying the mine area and tailings impoundment sites would be conducted in Alternatives 3 and 4.

Draft Findings for Transmission Line Certification Approval

This section summarizes the effects of the transmission line and serves as the draft findings for transmission line certification approval. The DEQ will approve a transmission line facility as proposed or as modified or an alternative to the proposed facility if it finds and determines:

- The need for the facility
- The nature of probable environmental impacts
- That the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives
- What part, if any, would be located underground
- That the facility is consistent with regional plans for expansion of the appropriate grid of the utility systems serving the state and interconnected utility systems
- That the facility will serve the interests of utility system economy and reliability
- That the location of the proposed facility conforms to applicable state and local laws
- That the facility will serve the public interest, convenience, and necessity
- That DEQ has issued all necessary decisions, opinions, orders, certifications, and permits
- That the use of public lands for location of the facility was evaluated, and public lands were selected whenever their use is as economically practicable as the use of private lands (75-20-301[1], MCA)

Need

In order to determine that there is a need for the proposed electric transmission line, the DEQ must make one of the findings enumerated in ARM 17.20.1606. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. The lead agencies considered, but eliminated from detailed analysis, alternatives other than a new transmission line. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

Probable Environmental Impacts

The probable environmental impacts of the transmission line are described in Chapter 3. The following sections summarize selected effects of the North Miller Creek Alternative (Alternative B) as proposed by MMC along with the agencies' alternatives: Modified North Miller Creek

Alternative (Alternative C), Miller Creek Alternative (Alternative D), and West Fisher Creek Alternative (Alternative E) using the preferred location criteria listed in DEQ Circular MFSA-2, section 3.1. These criteria are:

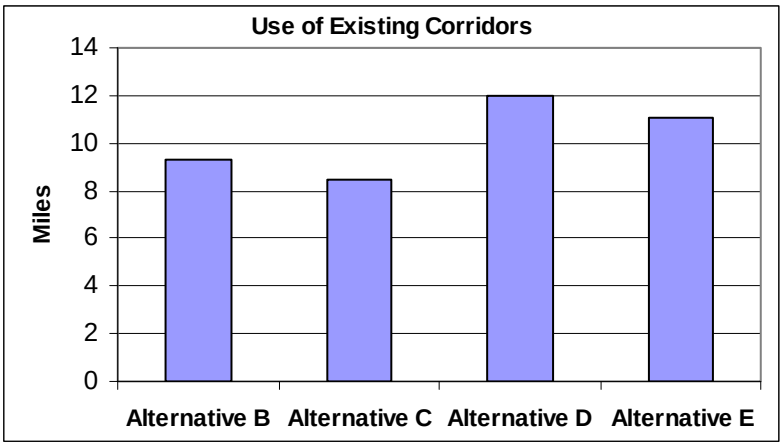
- Where there is the greatest potential for general local acceptance of the facility
- Where they use or parallel existing utility and/or transportation corridors
- Locations in non-residential areas
- Locations on rangeland rather than cropland and on non-irrigated or flood irrigated land rather than mechanically irrigated land
- Locations in logged areas rather than undisturbed forest
- Locations in geologically stable areas with non-erosive soils in flat or gently rolling terrain
- Locations in roaded areas where existing roads can be used for access to the facility during construction and maintenance
- Structures not located on a floodplain
- Where the facility will create the least visual impact
- A safe distance from residences and other areas of human concentration
- In accordance with applicable local, state, or federal management plans when public lands are crossed

None of the transmission line alternatives would cross rangeland or cropland. This preferred criterion is not discussed further. Alternative A, No Transmission Line, would not require the construction and operation of a transmission line. Electrical power would be provided by generators. The No Transmission Line Alternative would not provide a safe and reliable source of electrical power for the mine. Alternative A is not discussed in the following sections on the preferred location criteria.

General Local Acceptance. Issues and concerns about the proposed transmission line were identified during the public involvement process, discussed in Chapter 1. A public meeting on the proposed 230-kV transmission line was held in May 2005 to identify resources potentially affected by the proposed transmission line, suggested locations for the proposed line, alternatives to the proposed line, and mitigation measures for the proposed line. At the meeting, MMC presented information on the need for the proposed facility. Before making its minimum impact determination, the DEQ has solicited additional public comments on impacts of the alternatives as well as the balancing of preferred location criteria, possible impacts resulting from each alternative, and the use of public lands with project costs.

Use of Existing Corridors. No existing transmission line corridors are found in the analysis area. Existing transportation corridors consist of U.S. 2 and open roads on National Forest System lands, such as National Forest System road #231 or #278, and open roads on Plum Creek lands. Alternatives B through E would use or parallel existing road corridors. Alternatives B and C would be similar, with 8 to 9 miles of centerline within 1,000 feet of an existing open road. Alternatives D and E would make greater use of existing corridors, with between 11 and 12 miles centerline within 1,000 feet of these roads.

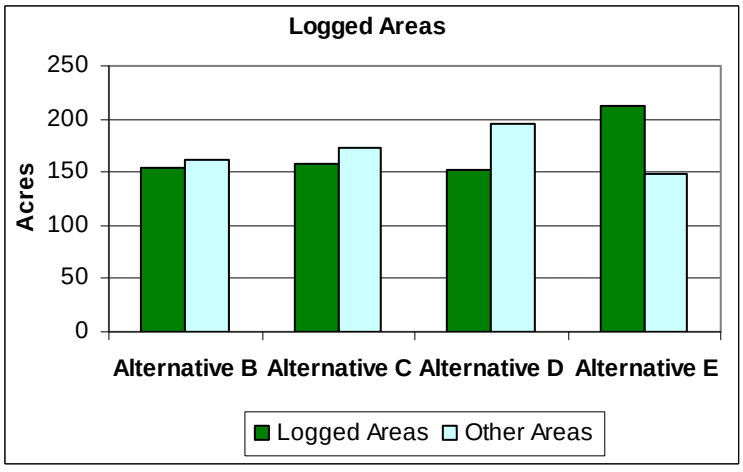
Location in Non-residential Areas. Most of the transmission line corridors are National Forest System lands or private lands owned by Plum Creek Timber Company. Residential areas are not found on either type of land. Fourteen residences are within 1 mile of the four transmission line alternatives. Most of these properties are within 0.5 mile of U.S. 2. Alternative B would be close to more residences than the other three alternatives. Fourteen residences are within 0.5 mile of Alternative B, of which 11 are greater than 450 feet from the centerline of the ROW and the remaining three are within 450 feet.



The seven residences within 0.5 mile of Alternatives C and D are more than 450 feet from the centerline. Six residences are within 0.5 mile of Alternative E, of which four are more than 450 feet from the line and the remaining two are within about 450 feet of the centerline. Montana regulations allow the final centerline to vary by up to 250 feet of the centerline analyzed in this EIS (ARM 17.20.301 (21)), unless there is a compelling reason to increase or decrease this distance. The centerline during final design of this alternative would be no closer than 200 feet of these residences.

Expected noise levels at a residence 400 feet from the centerline during a light rain or wet snows would be between 40 and 45 decibels. This sound level would be slightly above naturally occurring levels and would be faintly discernible. The sound level would be less than 20 decibels during fair weather, and would not be audible over existing sounds. Because BPA's Sedlak Park Substation would not contain a transformer, there would be no audible hum emanating from the substation.

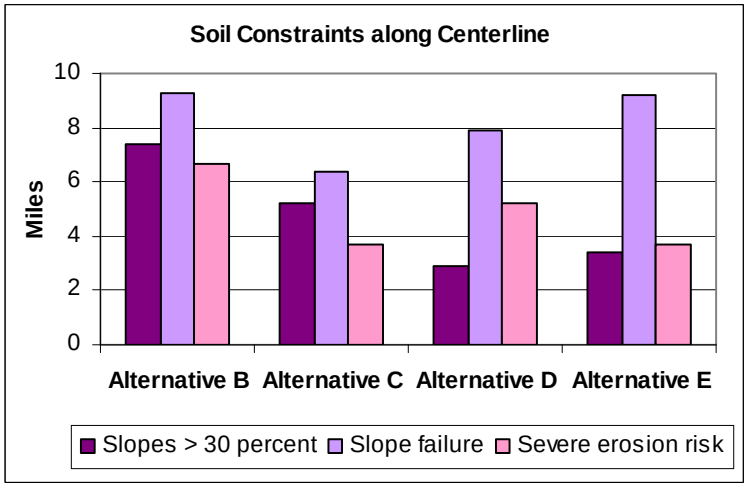
Logged Areas rather than Undisturbed Forest. Alternatives B through E would cross both logged areas and undisturbed forest, riparian, and other areas. About half the area crossed by Alternatives B and C has been logged. Alternative E would cross the most logged areas (210 acres) and least undisturbed areas (150 acres). Alternative D would cross the least logged areas (150 acres) and most undisturbed areas (195 acres).



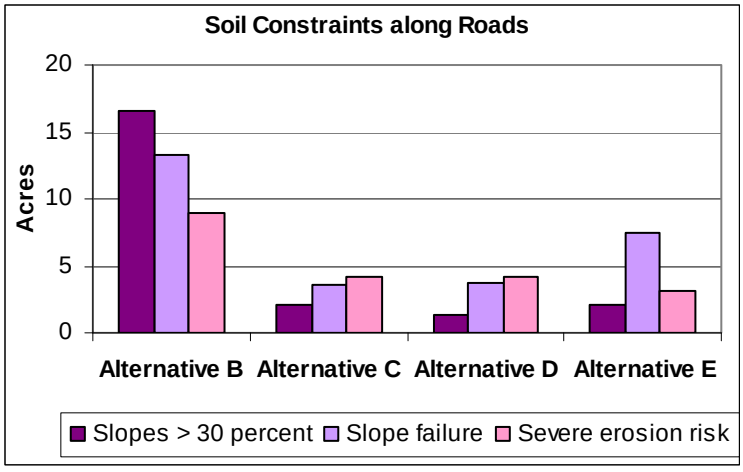
Geologically Stable Areas with Non-erosive Soils in Flat or Gently Rolling Terrain. The terrain in the transmission line analysis area consists of relatively flat alluvial valleys along major creeks and rivers, such as the Fisher River, Miller Creek and West Fisher Creek, or steep hillsides with

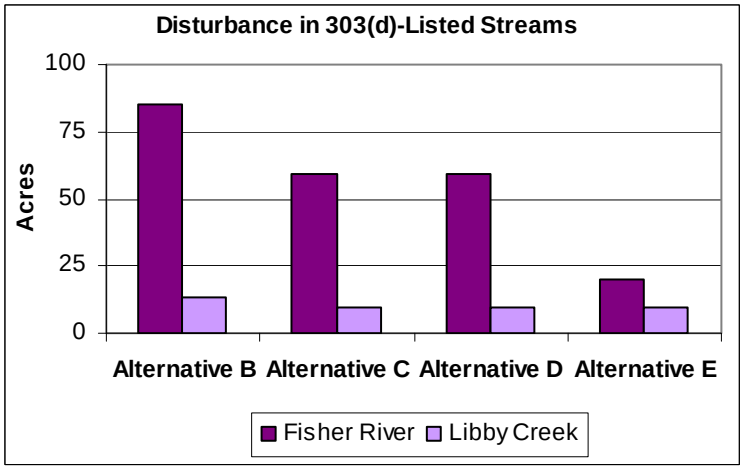
slopes greater than 30 percent. Soils subject to slope failure are found throughout the analysis area, primarily on lower hillslopes. Erosive soils are found along the Fisher River, Miller Creek, and West Fisher Creek.

Of the four alternatives, the centerline of the transmission line of the Alternative B would cross more steep areas (7.4 miles), more soils with a severe erosion hazard (6.7 miles), and more soils subject to failure (9.3 miles) than the other three alternatives. The centerline of Alternatives D and E would cross the least amount of steep slopes, crossing 3 miles of such slopes. The centerline of Alternative C would cross the least amount of soils subject to slope failure.



New or reconstructed access roads also would be needed on all transmission line alternatives. Alternative B would have more access roads than the other alternatives. In Alternatives C through E, the need for access roads would be reduced by using a helicopter to set structures in areas of poor accessibility. The access roads in Alternative B would disturb 8.9 acres of soil having severe erosion risk, 13.3 acres of soil having potential for slope failure, and 16.5 acres of slopes greater than 30 percent. Because of the fewer roads in the other alternatives, roads would disturb less than 5 acres of soils with these constraints in Alternatives C and D; Alternative E would disturb 7.4 acres of soils with risk of slope failure.

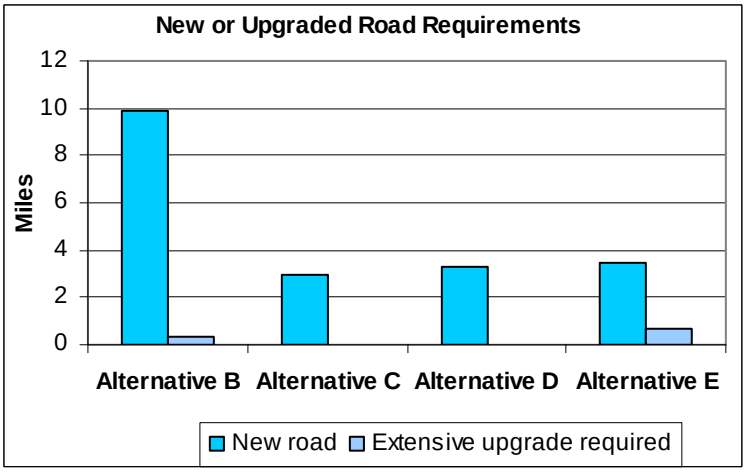




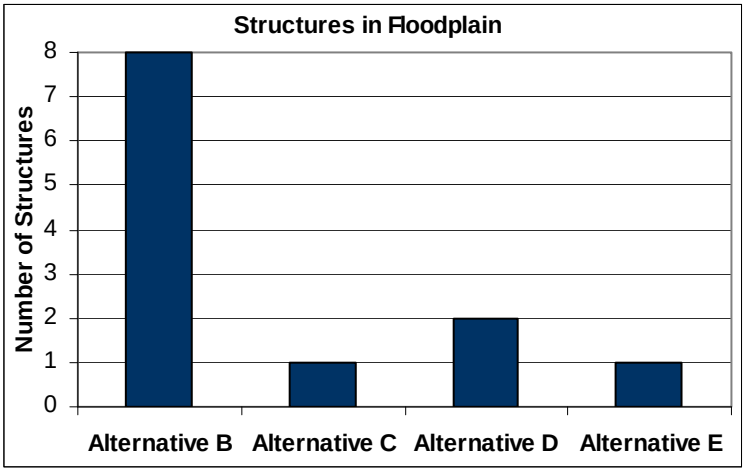
A segment of Libby Creek and the Fisher River are on Montana's list of impaired

streams. Alternative 2 would have 4.7 miles of line paralleling the Fisher River, where soils with severe erosion risk and high sediment delivery are found. Clearing for the transmission line and new or upgraded roads would disturb 85 acres in the watershed. Alternative 2 also would disturb 13 acres in the Libby Creek drainage. The soils at the Libby Creek crossing have severe erosion risk and high sediment delivery. Alternatives C and D would have fewer disturbances in the watersheds of 303(d)-listed streams, disturbing 59 acres in the Fisher River watershed and 10 acres in the Libby Creek watershed. Alternative E would have fewer disturbances in the Fisher River and Libby Creek watersheds than the other alternatives, disturbing 20 acres in the Fisher River watershed, and 10 acres in the Libby Creek watershed. Based on the use of best management practices (BMPs), Environmental Specifications, and other design criteria, these sediment increases would have minimal effects on analysis area streams under most conditions.

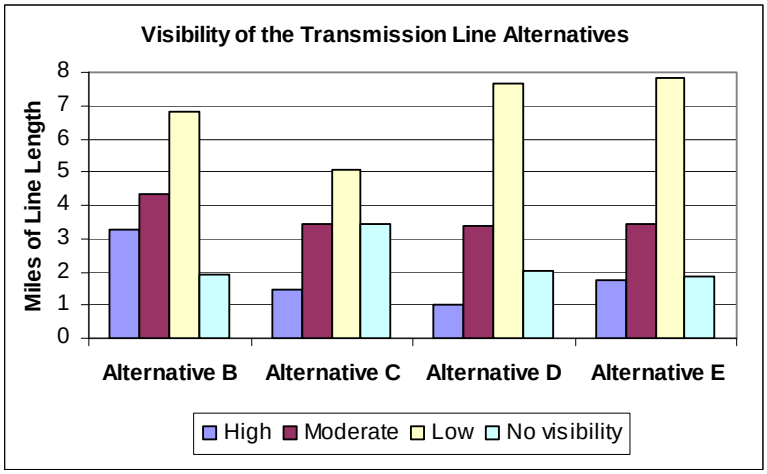
Roaded Areas. Existing roads are found throughout the transmission line analysis area. Most of the roads were used for timber harvest and are currently closed. Four open roads would be used as primary access by one or more the transmission line alternatives: U.S. 2, National Forest System road #231 (Libby Creek Road), National Forest System road #385 (Miller Creek-West Fisher Road), and National Forest System road #4724 (South Fork Miller Creek Road). Alternative B would require about 10 miles of new or roads with extensive upgrade requirements. In Alternatives C through E, the need for access roads would be reduced by using a helicopter to set structures in areas of poor accessibility. These alternatives would need 3 to 4 miles of new or upgraded roads.



Structures in a Floodplain. One-hundred-year floodplains have been designated along the Fisher River, Miller Creek, an unnamed tributary to Miller Creek, Ramsey Creek, and Libby Creek. Eight structures in Alternative B would be located in a designated 100-year floodplain, primarily along the Fisher River. One or two structures would be located in a designated 100-year floodplain in the other three alternatives.

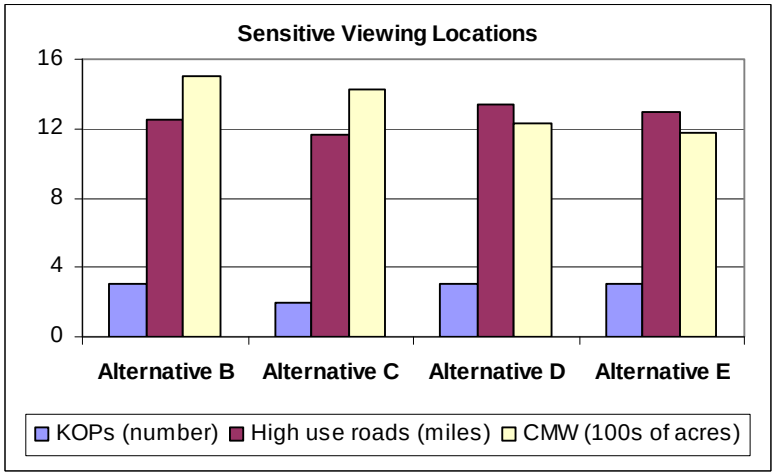


Visual Impact. The analysis area is characterized visually by the summit peaks of the Cabinet Mountains surrounded by the adjacent densely forested mountains and valleys, with some flat, open creek or stream valleys of dense low-growing herbaceous vegetation interspersed with the forest. The four transmission line alternatives would be located in montane forest and valley characteristic landscapes within the KNF.



About 3.3 miles of Alternative B would have a high visual impact and 4.4 miles would be moderate. Two miles of Alternative B would not be visible. Alternatives C, D, and E would have similar lengths of high and moderate visibility. Alternative C would have the greatest length of transmission line without any visibility at 3.4 miles.

All alternatives would be visible from KOPs, high use roads, and the CMW. Alternative C would be visible from the fewest KOPs (2) and high use roads (12 miles). Alternatives B, D, and E would be visible from two KOPs. Visibility from high use roads would be the greatest in Alternative D. Effects of views from the CMW would be the greatest in Alternative B and the least in Alternative E.



Safe Distance from Residences and Other Areas of Human Concentration. Fourteen residences are present within 0.5 mile of Alternative B, of which 11 are greater than 450 feet from the centerline of the right-of-way and the remaining three are within 450 feet. Because the final alignment could vary by up to 250 feet of the centerline analyzed in this EIS (ARM 17.20.301 (21)), three residences may be within 200 feet of the centerline depending on final transmission line alignment. At lateral distances from the edge of the right-of-way (50 feet from the centerline) to 200 feet away, the electric field strength would range from about 0.75 kV/m (kilovolt/meter) at 50 feet to about 0.05 kV/m (or 50 V/m) at 200 feet. The magnetic field strength would be about 4 milligauss (mG) at 50 feet and less than 1 mG at 200 feet. This maximum electric strength at 50 feet would be below the level set by Montana regulation for electric field strength, and both the electric and magnetic field strengths at 50 feet would be below the exposure levels for the general public recommended as reference levels or maximum permissible levels.

The seven residences along Alternative C and the eight residences along Alternative D within 0.5 mile are greater than 450 feet from the centerline. Seven residences are within 0.5 mile of Alternative E centerline, of which five are more than 450 feet from the centerline and the remaining two are within 450 feet of the centerline. As part of this alternative, the centerline would be not closer than 200 feet from any residence during final design. The electric field strength would be less than 0.05 kV/m (or 50 V/m) and the magnetic field strength would be less than 1.0 mG. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the general public, and the current state of scientific research on electric and magnetic fields, these alternatives would be a safe distance from residences and other areas of human concentration.

If approved, the DEQ would require that the project meet minimum standards set forth in the National Electrical Safety Code and Federal Aviation Administration requirements for marking the line.

Compliance with Local, State, or Federal Management Plans. The KFP guides all natural resource management activities and establishes management direction for the KNF 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 it may be established for only a part of the forest plan area, a MA. The Montanore Project is being evaluated under the 1987 KFP. Unincorporated Lincoln County has no comprehensive or general plan, zoning regulations, or growth policies.

The Montana Fish, Wildlife and Parks (FWP) holds a conservation easement on some lands owned by Plum Creek Timber Company where the transmission line may be located. Under the terms of the conservation easement, the FWP has reserved the right to prevent any inconsistent activity on or use of the land by Plum Creek Timber Company or other owners and to require the restoration of any areas or features of the land damaged by such activity or use. Activities and uses prohibited or restricted include installing any natural gas or other pipelines or power transmission lines greater than 25-kV unless the prior written approval is given by the FWP.

Alternative B would not be in compliance with all goals, objectives, standards, and guidelines of the KFP. For example, Inland Native Fish Strategy standard Minerals Management (MM-2) requires all structures, support facilities, and roads be located outside RHCAs. Where no alternative to siting facilities in RHCAs exists, operators are to locate and construct the facilities in ways that avoid impacts to RHCAs and streams and adverse effects on inland native fish. MMC's Alternative B would locate roads and transmission line structures in RHCAs. The lead agencies' modifications to MMC's proposed alignment and structure placement are incorporated into Alternative C, which would reduce the number of roads and transmission line structures in RHCAs. Compliance with the KFP is discussed in each resource section of Chapter 3. If the selected transmission line were approved by the FWP, it would be in compliance with the FWP-Plum Creek conservation easement.

Minimized Adverse Environmental Impact

The MFSA requires a finding that the facility as proposed or modified or an alternative to the facility must minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives(75-20-301(1)(c), MCA). ARM 17.20.1607 outlines additional requirements before this finding can be made. In addition,

the final location for the facility must achieve the best balance among the preferred site criteria discussed in the previous section.

In addition to the DEQ's preferred location criteria listed in DEQ Circular MFSA-2, section 3.1, transmission line impacts also were evaluated based on criteria listed in DEQ Circular MFSA-2, sections 3.2(1)(d)(iii) through (xi) and 3.4(1)(b) through (w) (see Appendix J) and other criteria established to meet Forest Service and NEPA requirements. Alternative A, No Transmission Line, would not have additional effects beyond that described for the mine, and is not discussed further. Impacts of transmission line alternatives are summarized below, based on the criteria listed in Appendix J. Other key issues addressed as required by the Forest Service or NEPA are discussed where they relate to DEQ Circular MFSA-2 criteria. Additional Forest Service or NEPA issues that do not fit in the context of MFSA criteria are discussed at the end of this section. Of the key issues identified by the KNF and the DEQ, the transmission line alternatives would have no effect on acid rock drainage, metal leaching, ground water quality or quantity, or surface water quantity, and these issues are not discussed further. The proposed transmission line would have no effect for the following resources listed in DEQ Circular MFSA-2 criteria: national primitive areas; national wildlife refuges and ranges; state wildlife management areas and wildlife habitat protection areas; national parks and monuments; state parks; national recreation areas; designated or eligible wild and scenic river systems; specifically managed buffer areas; state or federal waterfowl production areas; designated natural areas; national historic landmarks, districts, or sites; municipal watersheds; sage and sharp-tailed grouse breeding areas and winter range; high waterfowl population areas; areas of unusual scientific, educational, or recreational significance; areas of high probability of including significant paleontological resources; water bodies; potable surface water supplies, or active faults.

National Wilderness Areas. None of the alternatives would directly affect the wilderness attributes of the Cabinet Mountains Wilderness. Indirect effects to the Cabinet Mountains Wilderness are discussed below for Scenic Quality.

Roadless Areas over 5,000 acres. Alternative B would physically disturb 2 acres of the Cabinet Face East IRA in the Ramsey Creek drainage. Timber harvest for line clearing would occur in the IRA, and 0.1 mile of new roads would be constructed in the IRA under Alternative B. Alternatives C, D, and E would avoid physical disturbance in the Cabinet Face East IRA. No road construction or timber harvest would occur in the IRA.

Rugged Topography, Soil Erosion, and Sediment Delivery. The centerline of Alternative B would cross more areas with slopes greater than 30 percent (7.4 miles), more soils with a severe erosion hazard (6.7 miles), and more soils with high sediment delivery (5.1 miles) than the other three alternatives. The total disturbance for access roads, which would be either new roads or closed roads requiring upgrades, would be greater in Alternative B (30.9 acres) than the other alternatives, followed by Alternative E (12.7 acres). Of the agencies' alternatives, Alternative C would cross the most areas with slopes greater than 30 percent (5.2 miles), Alternative D would cross the most soils with a severe erosion hazard (5.2 miles), and Alternatives C and D would cross the most soils with high sediment delivery (1.5 miles). Slopes greater than 30 percent, areas with severe erosion hazard, and areas with high sediment delivery are shown for all transmission line alternatives in Appendix J.

To minimize erosion risk and sediment delivery, Alternative B would include implementation of erosion and sediment control BMPs; interim reclamation (replacing soil where it was removed

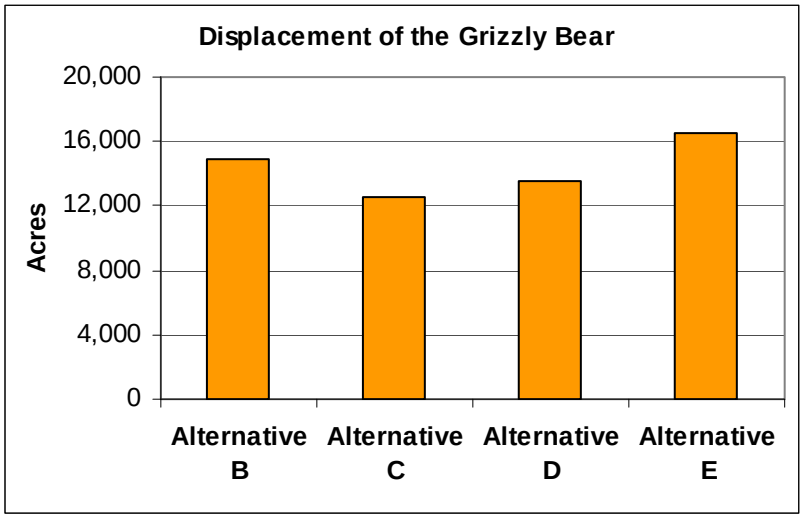
and reseeding) of access roads; immediate stabilization of cut-and-fill slopes; seeding, application of fertilizer, and stabilization of road cut-and-fill slopes and other disturbances along roads as soon as final post-construction grades were achieved; at the end of operations, decommissioning of new roads and reclamation of most other currently existing roads to pre-operational conditions; ripping of compacted soils prior to soil placement, and disking and harrowing of seedbeds. In addition to measures listed for Alternative B, Alternatives C, D, and E would minimize erosion risk and reduce sediment delivery through: re-routing to avoid highly erosive soils; use of H-frame poles, allowing longer spans and fewer structures and access roads; helicopter construction in grizzly bear core habitat to decrease number of access roads; and implementation of a Road Management Plan. For all transmission line alternatives, with implementation of mitigation measures there would be no severe reclamation constraints, no significant adverse impacts to the soil resources, and the soil losses along access roads would likely be minor until vegetation was re-established in most areas after 3 to 5 years. Vegetation re-establishment on steep areas, particularly on south- and west-facing slopes, would take longer.

Bull Trout Critical Habitat and Occupied Habitat and other Fisheries. The Fisher River, West Fisher Creek, Libby Creek, and Ramsey Creek in the transmission line analysis area provide habitat for bull trout, listed as threatened under the ESA. Critical bull trout habitat is found in two segments of West Fisher Creek, 1 to 2 miles west of U.S. 2. Because of barriers, bull trout are not found in Miller Creek or its tributaries.

Bull trout could be affected by increased sedimentation caused by clearing, road construction, and other disturbance associated with the transmission line. All alternatives may affect bull trout and designated critical habitat. All alternatives would cross Howard and Libby creeks 0.3 to 0.4 mile upstream of designated critical habitat on Libby Creek. Alternative E would parallel the designated critical bull trout habitat in West Fisher Creek. The existing Libby Creek Road (National Forest System road #231) would be between the line in Alternative E and any new roads, and West Fisher Creek. As shown in Appendix J, Alternative E would have the most structures within 1 mile of bull trout critical habitat (28), and Alternative B would disturb the most habitat for road construction and upgrades within 1 mile of bull trout critical habitat (3.5 acres). Alternative D would have the fewest structures within 1 mile of bull trout critical habitat (6), and disturb the least habitat for road construction and upgrades within 1 mile of bull trout critical habitat (0.6 acres). Alternative B would result in the most disturbance from clearing and road construction or upgrades in watersheds of occupied bull trout streams (181 acres), followed by Alternative E (179 acres). Alternative D would result in the least disturbance in watersheds of occupied bull trout streams (84 acres).

Three Montana fish Species of Concern are found in the transmission line analysis area streams: interior redband trout, westslope cutthroat trout, and torrent sculpin. Pure populations of interior redband trout are found in the Fisher River, West Fisher Creek, Ramsey Creek, a short segment of Libby Creek below Ramsey Creek, and Midas Creek. Torrent sculpin are found in Libby Creek and Miller Creek. Both torrent and slimy sculpin are found in analysis area streams and cannot be readily identified based on external morphology. Westslope cutthroat trout are found in Howard Creek and Miller Creek. Fish species of concern also are found in Midas Creek and Standard Creek. The transmission line alternatives would result in only minor disturbance in these watersheds, which is unlikely to affect aquatic life. None of the transmission line alternatives would likely contribute to a trend toward federal listing or cause loss of viability of the population of westslope cutthroat trout or interior redband trout.

In addition to mitigation measures described above to minimize erosion and sediment delivery, Alternative B would include implementation of a Storm Water Pollution Prevention Plan and structural and non-structural BMPs; construction of stream crossings per KNF and DEQ requirements; minimization of disturbance on active floodplains; and curtailment of construction activities during heavy rains. Alternatives C, D, and E also would include the following measures: where feasible, location of structures outside of riparian areas; installation of new culverts to allow fish passage; design of stream-crossing structures to withstand a 100-year flow event; and the completion of a habitat inventory and development of instream structures in Libby Creek. Based on the use of BMPs, Environmental Specifications, and other design criteria, sediment increases would have minimal effects on analysis area streams under most conditions.



Grizzly Bear. As discussed in the previous summary of the mine alternatives, an analysis of the independent effects of the transmission line alternatives on the grizzly bear was not completed because of the analysis' complexity. The effects of the combined mine and transmission line alternatives have been discussed previously. The following is an estimate of the effects of the transmission line alternatives. The physical loss of grizzly bear habitat would be low, ranging from 13 to 14 acres in Alternatives C, D, and E to 40 acres in Alternative B. Physical loss would be primarily from construction of roads and the Sedlak Park Substation. The grizzly bear would be displaced temporarily from habitat in all alternatives, ranging from 12,582 acres in Alternative C to 16,501 acres in Alternative E. Some areas affected by displacement from transmission line activities are currently being affected by other activities, such as road use. In all alternatives, displacement effects would be primarily due to helicopter activity. In all alternatives, helicopters would be used for line stringing, which would last about 10 days. In Alternatives C, D, and E, helicopters also would be used in some segments for vegetation clearing and structure construction, prolonging disturbance for up to 2 months. For all alternatives, disturbance of a similar duration also would occur during other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than Alternative C, D, or E. For all transmission line alternatives, except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activity would cease after the transmission line was built until decommissioning. Helicopter use and other transmission line construction activities would cause similar disturbances with similar durations during line decommissioning. Alternatives B and C would follow similar routes, with the exception of the segment of Alternative B in the Ramsey Creek drainage. Alternative C would increase short-term helicopter displacement effects during construction but would reduce road requirements relative to Alternative B. Effects on the grizzly bear would be mitigated through habitat acquisition, access changes, and habitat enhancement.

Small, isolated blocks of core habitat may provide lower quality habitat than large, interconnected blocks. Research suggests that grizzly bears prefer larger blocks of core, although a minimum block size was not determined due to small sample sizes (Wakkinen and Kasworm 1997). During transmission line construction, new road construction in Alternative B would divide and reduce a block of core habitat in the northeast portion of BMU 6, where a narrow band of core habitat occurs, resulting in one large block and two smaller blocks. Core habitat fragmentation would continue until the transmission line was decommissioned in Alternative B. The transmission line alignment in Alternative C would cross the block of core habitat in the northeast portion of BMU 6, but would not reduce core habitat because helicopters would be used for construction in or adjacent to core habitat. Displacement effects from helicopter activity during construction, annual maintenance throughout the project, and transmission line decommissioning in Alternatives B and C would reduce effectiveness of this core habitat block. In Alternatives B and C, core habitat would be altered with a linear transmission line corridor, reducing cover and increasing forage habitat. Clearing of the transmission line corridor could result in improved hunter access, increasing mortality risk.

Alternatives C, D, and E include an access change in NFS road #4725 that would enlarge a block of core habitat in the northeast portion on BMU 6. In Alternatives D and E, the access change would be in the entire length of NFS road #4725 and would be implemented before transmission line construction started. In Alternative C, the additional core habitat created by the access change in NFS road #4725 would be 320 acres smaller and would occur later than in Alternatives D and E. The entire length of NFS road #4725 would be used during construction of Alternative C, and the access change would occur in the upper 2.8 miles of NFS road #4725 after it was no longer needed for transmission line construction.

Canada Lynx. Impact evaluation criteria for the Canada lynx have been discussed in the previous summary of the mine alternatives. All transmission line alternatives would comply with Lynx Amendment standards with the following exception. All transmission line alternatives would affect multi-story or late-successional forest snowshoe hare (lynx denning) habitat and would not meet this standard. Impacts to lynx denning habitat would range from 19 acres for Alternatives C and D, to 31 acres for Alternative B (see Appendix J). Overall lynx habitat disturbed in the transmission line clearing area or for road construction or improvement would range from 79 acres for Alternative C to 193 acres for Alternative D. All transmission line alternatives may affect the Canada lynx. Land acquired for grizzly bear mitigation for the transmission line alternatives would likely improve habitat conditions for lynx and their prey.

Gray Wolf. Impact evaluation criteria for the gray wolf have been discussed in the previous summary of the mine alternatives. The Fishtrap pack is the only known wolf pack potentially affected by the Montanore Project. At least two wolves use portions of the analysis area on a regular basis. No wolf packs or den sites have been confirmed in this general area.

For all transmission line alternatives, sufficient populations of elk, deer and other prey species would continue to be maintained, and would continue to provide a good year-round prey base for wolves, and no known den or rendezvous sites would be affected by any of the transmission line alternatives. Only the outer edge of the Fishtrap pack territory extends to the extreme southeast portion of the analysis area and the Fishtrap pack would not likely be affected by any of the transmission line alternatives. High road densities and transmission line construction activities could have short-term effects on other wolves using the analysis area. Increased road densities, could result in increased potential for human disturbance and an increased risk of human-caused

wolf mortality. During transmission line construction, all transmission line alternatives except Alternative D would increase road densities in the analysis area. Road densities would increase the most for Alternative B. For all transmission line alternatives, open road densities on National Forest System lands would return to existing densities during transmission line operations and after reclamation. Helicopter use and other transmission line construction and ground construction activities could temporarily displace wolves from surrounding habitat. Impacts to wolf habitat would be somewhat reduced through the land acquisition programs proposed by MMC and the agencies especially where roads could be closed. In Alternatives C, D, and E, potential impacts to wolves would be minimized through road access changes that would create security habitat for prey species and reduce motorized access of wolf habitat, prohibiting employees to carry firearms, removing road-killed big game animals, implementing a transportation plan to reduce mine traffic, and monitoring road-killed animals. Overall, all transmission line alternatives would have a minimal effect on the gray wolf.

Cultural Resources. Four eligible cultural sites would be located in the Alternative B alignment and 500-foot buffer, while the buffer area for Alternatives C, D, and E would include three eligible cultural sites. Details about these sites are explained in Chapter 3. For all transmission line alternatives, consultation with the SHPO would be conducted to receive consensus determinations and to develop a plan of action for site 24LN1818. Site 24LN1818 is a portion of U.S. 2 that crosses Alternatives B, C, and D. Because of the ongoing highway modifications, the resource has not been evaluated for the National Register of Historic Places. Additional fieldwork would be necessary prior to SHPO consultation.

Surface Water Quality. Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Howard Creek, and Midas Creek are rated as outstanding (Class 1) for fisheries habitat by the FWP. Clearing within watersheds of Class I or Class II streams would range from 47 acres for Alternatives C and D to 107 acres for Alternative B. Road construction and improvement would disturb less than 1 acre in watersheds of Class I or Class II streams for Alternatives C, D, and E, and 7 acres for Alternative B (see Appendix J).

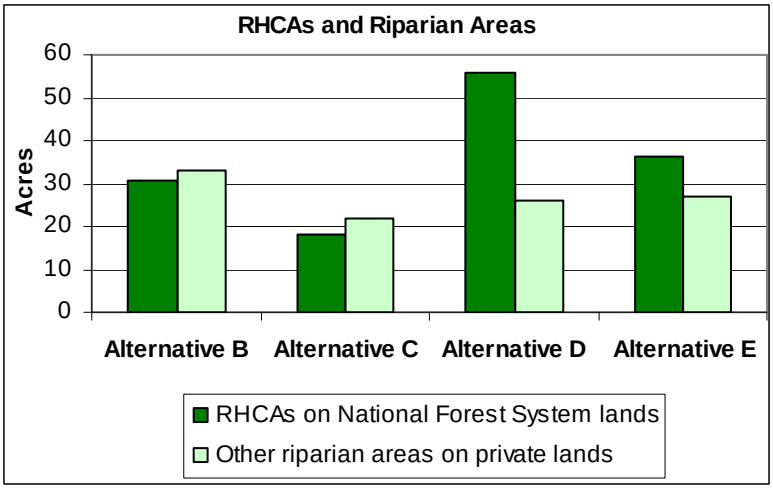
Stream segments on Montana's 303(d) list of impaired streams in the analysis area are described in the previous summary of the mine alternatives. Clearing within watersheds of 303(d)-listed streams would range from 29 acres for Alternative E to 95 acres for Alternative B. Road construction and improvement disturbance in watersheds of 303(d)-listed streams would range from less than 1 acre for Alternative E to 4 acres for Alternative B (see Appendix J).

Scenic Quality. In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by reallocating certain areas disturbed by the 230-kV transmission line on National Forest System lands as MA 23. MA 23 has a Visual Quality Objective (VQO) of Maximum Modification. The MAs that would not be reallocated to MA 23 currently have a VQO of Maximum Modification. All transmission line facilities would be in compliance with a VQO of Modification or Maximum Modification. Some segments of all transmission line alternatives would be visible from some locations within the Cabinet Mountains Wilderness, as shown in Appendix J.

Big Game Winter and Security Habitat. All transmission line alternatives would disturb winter habitat for moose, elk, and white-tailed deer and security habitat for elk. Security habitat offers elk refuge and reduces their vulnerability during the hunting season. For this analysis, elk security habitat is defined as areas that are larger than 250 contiguous acres and more than 0.5 mile from an open road. Alternative C would disturb the most elk winter range (174 acres), and Alternative

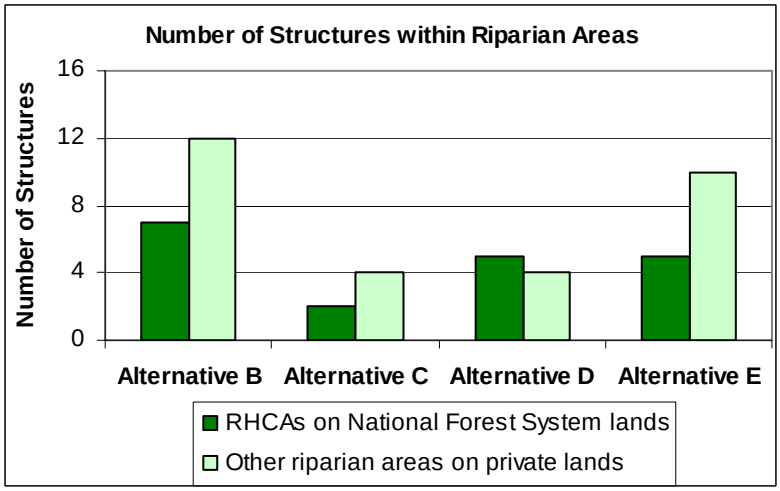
E would disturb the least (93 acres) (see Appendix J). Disturbance impacts to white-tailed deer winter range would range from 149 acres for Alternative B to 208 acres for Alternative D. The most moose winter range would be disturbed by Alternative E (210 acres) and the least by Alternative B (146 acres). Only Alternatives B and C would affect elk security habitat, disturbing 49 acres and 84 acres, respectively. For all transmission line alternatives, impacts to big game winter habitat would be mitigated through winter construction timing restrictions in white-tailed deer winter range. Land acquisition programs proposed by MMC and the agencies, especially where roads could be closed, also would mitigate impacts to big game. Additional mitigation measures included in Alternatives C, D, and E would be the creation of security habitat through road access changes and monitoring road-killed animals to determine if improved access results in increased wildlife mortality.

Mountain Goat. Only Alternative B would physically disturb mountain goat habitat, affecting 47 acres. Helicopter use and other transmission line construction activities associated with the transmission line alternatives are described above for grizzly bear. Helicopter and other transmission line construction activities could temporarily displace goats from suitable habitat or reduce their ability to effectively use the available habitat in the short term. Individual goats could suffer increased stress levels from helicopter and construction disturbance. During the construction phase, Alternative B would result in additional short-term disturbance to 3,877 acres of goat habitat, primarily due to helicopter line stringing in the Ramsey Creek area. Additional disturbance effects would be less for Alternatives C, D, and E, ranging from 624 acres for Alternative C to 729 acres for Alternatives D and E. Impacts to mountain goats could be reduced through land acquisition programs proposed by MMC and the agencies, if acquired land provides suitable goat habitat and could be managed to benefit mountain goats.

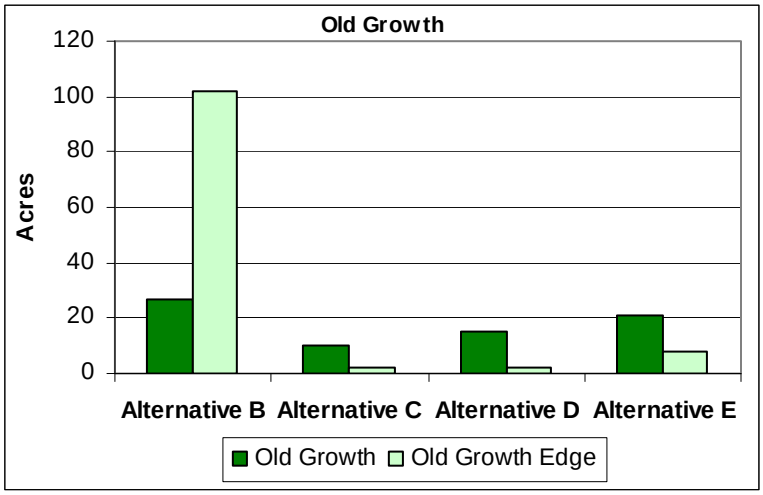


Riparian Habitat Conservation Areas. Alternatives B through E would require construction of roads and other facilities in RHCAs and other riparian areas. Protection of RHCAs was a key criterion in the alternatives analysis and development of alternatives. The lead agencies did not identify a practicable alternative that would avoid locating transmission line facilities or timber harvest in RHCAs. Effects on RHCAs would range from 18 acres in Alternative C to 56 acres in Alternative D; effects on riparian areas on state and private land would range from 22 acres in Alternative C to 33 acres in Alternative B. In Alternatives C, D, and E, MMC would develop and implement a final Road Management Plan to reduce effects on RHCAs. The plan would describe for all new and reconstructed roads criteria that govern road operation, maintenance, and management; requirements of pre-, during-, and post-storm inspection and maintenance; regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives;

implementation and effectiveness monitoring plans for road stability, drainage, and erosion control; and mitigation plans for road failures.



A KFP standard is to locate structures and support facilities, such as transmission line, outside of RHCAs, unless no alternative exists. Alternative B would have more structures located in RHCAs and other riparian areas, with seven structures on RHCAs and 12 structures on riparian areas on state and private land. Structures in RHCAs in the other alternatives would be fewer, ranging from two in Alternative C and five in Alternatives D and E. Similarly, fewer structures would be located in other riparian areas in the other alternatives, ranging from four in Alternatives C and D, and 10 in Alternative E. Effects on RHCAs in Alternatives C, D, and E would be minimized by development and implementation of a Vegetation Removal and Disposition Plan. Heavy equipment use in RHCAs would be minimized. Shrubs in RHCAs would be left in place unless they had to be removed for safety reasons.



Old Growth Habitat. Old growth in the transmission line corridors is found in small blocks along the Fisher River, Miller Creek, West Fisher Creek, and Libby Creek. Alternatives B through E would remove old growth and reduce the effectiveness of old growth adjacent to new disturbances. Loss of old growth would range from 10 acres in Alternative C to 27 acres in Alternative B. Edge effects would range from 102 acres in Alternative B to 2 acres in Alternatives C and D. Increased new road construction contributes to the edge effect of Alternative B. The reduction of old growth on National Forest System lands would be mitigated in Alternatives C, D, and E by the designation of undesignated old growth to designated old growth (MA 13).

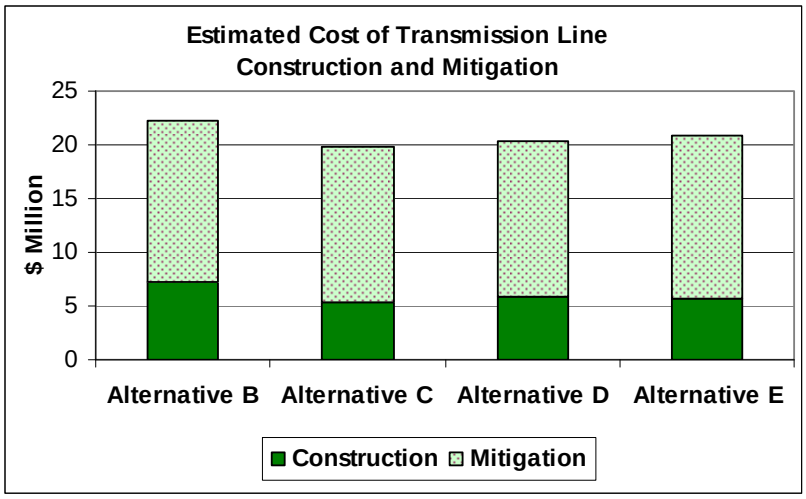
Transmission line Alternatives B through E would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 designation of all harvested stands to MA 23. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. Losses and degradation of old growth

habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels. All alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each 3rd-order drainage or compartment, or a combination of compartments.

Pileated Woodpecker. The pileated woodpecker is a Management Indicator Species (MIS) for old growth and snag habitat in the KNF. The effects on old growth in the transmission line alternatives, especially edge effects, would reduce nesting and foraging habitat and habitat quality for the pileated woodpecker. The potential population index in the transmission line alternatives would not be affected. All transmission line alternatives would result in the loss of snags and downed logs greater than 10 inches diameter at breast height that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain above KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and they could be managed to benefit pileated woodpeckers.

Wetlands. Direct effects to wetlands and waters of the U.S. are expected to be mostly avoided by placement and location of the transmission structures outside of wetlands and waters of the U.S. The BPA would avoid all wetlands at the Sedlak Park Substation Site. Unavoidable wetland direct effects would be determined during final design. No isolated wetlands were identified within the clearing area of any transmission line alternative. About 1.6 acres of wetlands would be within the Alternative B transmission line clearing area. No wetlands would be in the clearing area for Alternatives C, D, and E. Waters of the U.S. within the clearing area would range from 1.2 acres for Alternative C to between 8.2 and 10.2 acres for Alternatives B, D, and E. For all transmission line alternatives, new or upgraded road construction would affect less than 0.2 acre of wetlands and waters of the U.S. Indirect effects to wetlands from road construction, such as sediment or pollutant delivery, would be minimized through implementation of BMPs and appropriate stream crossings.

Transmission Line Construction Costs. Resource-specific impacts and cumulative impacts are described in the previous section and discussed in Chapter 3. Monetary values of these impacts cannot reasonably be quantified. Many potential adverse environmental impacts would be minimized through measures proposed by MMC and the application of the agencies' proposed measures that would be included in Environmental Specifications. Agency proposed mitigation measures would be included as conditions in the certificate should the DEQ approve the transmission line. Proposed Environmental Specifications for the transmission line, including environmental protection and monitoring measures, are described in Appendix D and are further detailed in ARM 17.20.1901.



Estimated transmission line construction costs range from $7.3 million for Alternative B to $5.4 million for Alternative C. High steel costs would make the steel monopoles proposed in Alternative B considerably more expensive than the wooden H-frame structures proposed in the other alternatives. The lower cost of wooden H-frame structures in Alternatives C, D, and E would offset the cost of helicopters to set structures and clear timber in these alternatives. Estimated mitigation costs range from $14.4 million for Alternative C to $15.0 million for Alternative E. Cost estimates are based on preliminary design and material costs in early 2008.

Locating Transmission Lines Underground

No part of the transmission line would be built underground. Digging trenches to bury the lines would require greater construction disturbance and would require longer time to install. The need for access roads and the associated surface disturbance would be greater. Except along the drainage bottoms, the analysis area is steep, with slopes greater than 30 percent common. Underground line installation and access road construction on steep slopes would have more environmental impact than above-ground construction. Above-ground access vaults would need to be constructed as well as above-ground structures at line termination points. Vegetation would likely have to be restricted to avoid reducing soil moisture needed to cool the transmission line. Problems with an underground system also would be more difficult to locate and repair. An underground transmission line would cost between 1.5 and 5 times the amount required to build an overhead line (Electric Power Research Institute 2006). Locating the transmission line underground was dismissed because of the greater surface disturbance and cost.

Consistency with Regional Plans for Expansion

The transmission line would allow the mine to connect to the regional electrical transmission grid. While there is no single formal published plan for expansion of the regional grid, the line would be consistent with plans for expansion of the BPA grid in the area. The line would not significantly add to the ability of the grid as a whole to deliver electricity because the purpose of the line would be to serve only the mine loads. The BPA has completed the studies necessary to interconnect the proposed line to BPA's Libby-Noxon 230-kV line. BPA's study indicated the proposed line would not have a significant effect on the interconnected system (Bonneville Power Administration 2006).

Utility System Economy and Reliability

The BPA has completed the study indicating that the proposed interconnection would not adversely affect BPA's system (Bonneville Power Administration 2006). Operating the proposed line at 230 kV would help ensure low line losses.

Conformance with Applicable State and Local Laws

The location of the facility would conform to applicable state and local laws and regulations either as a permitting or certification condition or in compliance with project-specific Environmental Specifications (see Chapter 1).

Public Interest, Convenience, and Necessity

The proposed transmission line would be built to meet the need for additional transfer capacity to the mine. Benefits to MMC would be the monetary profit from operating the mine and transmission line. Benefits to the state include local tax revenues to counties in which the line and mine are located, state tax revenues from the line and mine, a short-term beneficial effect on local economies from construction of the line and mine, and a long-term beneficial effect on local economies from maintenance of the line.

Economic impacts due to the proposed transmission line would be minimal at a state level. Construction benefits due to the line would be short-term. Line maintenance employment benefits and tax benefits would be long-term but small at both a county and state level. Total costs include mine and transmission line construction and operation costs and costs due to environmental impacts described in Chapter 3. Costs of these environmental impacts cannot be reasonably quantified in monetary terms.

The proposed transmission line is unlikely to have adverse affects on public health, welfare, and safety because the line would conform to the requirements of the National Electrical Safety Code and DEQ standards for electric field strength in residential or subdivided areas and at road crossings. Sensitive receptors such as residences would be located at distances sufficient that even the most restrictive suggested standards for magnetic fields would be met under normal operating conditions. Alternatives C, D, and E would be constructed in a manner that minimizes adverse impacts to soil, water, and aquatic resources.

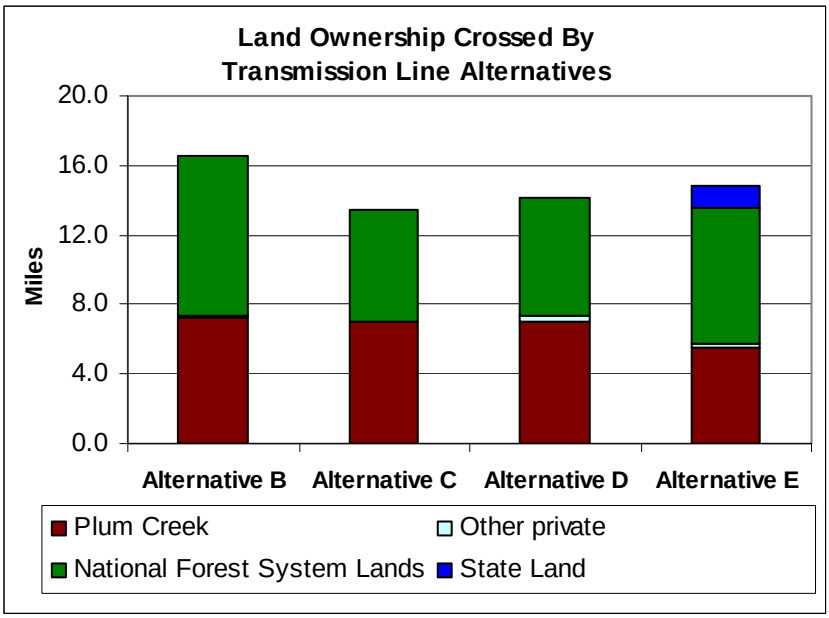
The DEQ will consider additional comments on the benefits and costs of the Montanore line, and will make a final determination on public interest, convenience, and necessity after comments on this Draft EIS are analyzed.

Public and Private Lands

The use of public lands for location of the facility was evaluated, and public lands were incorporated into alternatives whenever their use was as economically practicable as the use of private lands (75-20-301(1)(h), MCA). All of the transmission line alternatives would be located primarily on National Forest System lands and private land owned by Plum Creek. Alternative B, C, and D would cross between 7 and 7.4 miles of private and Plum Creek land. Alternative E would cross the least amount of private land (5.7 miles). The agencies did not identify an alternative that would avoid the use of private land.

DEQ Issuance of Necessary Decisions, Opinions, Orders, Certifications, and Permits

As appropriate, the DEQ would issue all necessary environmental permits for the transmission line at the time the decision is made on whether to grant a certificate for the facility.



Where to Obtain More Information

More information on the proposed Montanore Project can be found on the KNF's website: www.fs.fed.us/r1/kootenai/projects/projects/montanore/index.shtml, or the DEQ's website: http://www.deq.mt.gov/eis.asp. If you have any additional questions or concerns, please contact the individuals listed below.

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Appendices

Appendix A—1993 Board of Health and Environmental Sciences Order
Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternatives
Appendix C—Surface Water, Ground Water, and Aquatic Life Monitoring Plans, Alternatives 3 and 4
Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line
Appendix E—Past and Current Actions Catalog for the Montanore Project
Appendix F—Supplemental Macroinvertebrate Data
Appendix G—Water Quality Mass Balance Calculations
Appendix H—Various Streamflow Analyses
Appendix I—Visual Simulations
Appendix J—Transmission Line Minimal Impact Standard Assessment

Chapter 1. Purpose of and Need for Action

1.1 Document Structure

Montanore Minerals Corp. (MMC) proposes to construct a copper and silver underground mine and associated facilities, including a new transmission line. The proposed project is called the Montanore Project. MMC has requested the U.S. Department of Agriculture (USDA), Kootenai National Forest (KNF) to approve a Plan of Operations for the Montanore Project.

From the DEQ's perspective, the mining operation is covered by a DEQ Operating Permit first issued by the Montana Department of State Lands (DSL) to Noranda Minerals Corp. (Noranda). MMC has applied to the Montana Department of Environmental Quality (DEQ) for a modification of the existing permit to the extent that its proposed Plan of Operations submitted to the KNF differs from the DEQ Operating Permit. MMC has also applied to the DEQ for a certificate of compliance to allow for construction of the transmission line.

The KNF and the DEQ are the lead agencies and have prepared this draft environmental impact statement (Draft EIS) in compliance with the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA). These laws require that if any action taken by the DEQ or the KNF may "significantly affect the quality of the human environment," an Environmental Impact Statement (EIS) must be prepared. This Draft EIS also has been prepared in compliance with the USDA NEPA policies and procedures (7 Code of Federal Regulations (CFR) 1b), the Forest Service's Environmental Policy and Procedures Handbook (Forest Service Handbook 1909.15), DEQ's MEPA regulations (ARM 17.4.601 *et seq.*) and the U.S. Army Corps of Engineers' (Corps) NEPA implementation procedures for its regulatory program (Appendix B of 33 CFR 325). This Draft EIS discloses the potential direct, indirect, and cumulative environmental impacts that would result from the proposed mine and alternatives and serves as a draft of a report required under the Major Facility Siting Act (MFSA). The document is organized into four chapters:

- Chapter 1. Purpose of and Need for Action: Chapter 1 includes information on the history of the proposed project, the purpose of and need for the proposed project, and the lead agencies' proposal for achieving that purpose and need.
- Chapter 2. Alternatives, Including the Proposed Action: This chapter summarizes how the KNF and the DEQ informed the public of the proposal and how the public responded. This chapter provides a more detailed description of MMC's Proposed Action as well as the lead agencies' alternative methods for achieving the project's purpose. These alternatives were developed based on key issues raised by the public and other agencies and include mitigation measures to reduce impacts.
- Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the affected environment and environmental effects of implementing the Proposed Action or other alternatives. This analysis is organized alphabetically by resource.
- Chapter 4. Consultation and Coordination: Chapter 4 provides a list of preparers and agencies consulted during the development of the Draft EIS.

Appendices: The following appendices provide more detailed information to support the analyses presented in the Draft EIS:

- Appendix A—1992 Board of Health and Environmental Sciences Order
- Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternatives
- Appendix C—Surface Water, Ground Water, and Aquatic Life Monitoring Plans, Alternatives 3 and 4
- Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line
- Appendix E—Past and Current Actions Catalog for the Montanore Project
- Appendix F—Supplemental Macroinvertebrate Data
- Appendix G—Water Quality Mass Balance Calculations
- Appendix H—Various Streamflow Analyses
- Appendix I—Visual Simulations
- Appendix J—Transmission Line Minimal Impact Standard Assessment

Additional documentation, including more detailed analyses of project-area resources, may be found in the project record located at the KNF Supervisor's Office in Libby, Montana, and in the project record at DEQ's Environmental Management Bureau in Helena, Montana.

This disclaimer pertains to all geographic information system (GIS) maps within this document:

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1.2 Project Area Description

The Montanore Project is located 18 miles south of Libby near the Cabinet Mountains of northwestern Montana (Figure 1; all figures are bound separately in Volume 3 of this document). The ore body is beneath the Cabinet Mountains Wilderness (CMW). All access and surface facilities including the 230-kV transmission line would be located outside of the CMW boundary (Figure 2). The proposed operating permit areas for the mine facilities would be within sections 13, 14, 15, 22, 23, 24, 26, 27, 35, and 36, Township 28 North, Range 31 West, sections 2, 3, 9, 10, 11, 14, 15, and 29, Township 27 North, Range 31 West, and sections 18 and 19, Township 28 North, Range 30 West, all Principal Meridian, in Lincoln and Sanders counties, Montana.

1.3 Background

1.3.1 Mineral Rights

On January 1, 1984, the CMW was withdrawn from mineral entry under provisions of the Wilderness Act, subject to valid existing rights. The Wilderness Act requires federal agencies, such as the KNF, to ensure that valid rights exist prior to approving mineral activities inside a congressionally designated wilderness. 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 have maintained that discovery.

The discovery of mineral deposits for the Montanore Project dates back to the early 1980s. In 1980, Heidelberg Silver Mining Company (Heidelberg) located certain mining claims in sections 29 and 30 of Township 27 North, Range 31 West, P.M., Sanders County, Montana. Subsequently, in 1983, Pacific Coast Mines, Inc. (Pacific), a subsidiary of U.S. Borax and Chemical Corporation (Borax), located other mining claims in sections 29 and 30 of Township 27 North, Range 31 West, P.M., Sanders County, Montana. The mining claims located by Pacific in 1983 included the lode mining claims Hayes Ridge (HR) 133 and HR 134 adjacent to Rock Lake. (These claims are shown on Figure 11) This outcrop contained stratabound copper-silver mineralization, extending over a 200-foot vertical thickness.

The deposit is part of the Rock Creek-Montanore deposit, as described by Boleneus *et al.* (2005). The Rock Creek-Montanore deposit has two sub-deposits, the Rock Lake sub-deposit, which was discovered by Pacific, and the Rock Creek sub-deposit, which is proposed to be mined by the Rock Creek Project. The Rock Creek portion of the deposit is separated from the Montanore (Rock Lake) portion by the Rock Lake fault. Exploration drilling was conducted across the deposit in 1983 and 1984.

In 1984, Pacific leased Heidelberg's mining claims pursuant to the terms of a 1984 Lease and Option to Purchase Agreement (Lease Agreement). Subsequently, in 1988, Heidelberg was merged into Newhi, Inc. (Newhi), a subsidiary of Mines Management, Inc. (MMI). As a result of that merger, Newhi became the successor in interest to Heidelberg under the Lease Agreement. Also in 1988, Pacific assigned its interest in HR 133 and HR 134 and its interest in the Lease Agreement to Noranda Minerals Corporation (Noranda), a subsidiary of Noranda Finance Inc. (Noranda Finance).

In 1991, Noranda filed an application with the Bureau of Land Management (BLM) for patent of the HR 133 and HR 134 mining claims (Patent Application MTM 80435). In 1993, a Mining Claim Validity Report was issued by BLM recommending that BLM issue a patent to Noranda for HR 133 and HR 134. In 2001, a patent was issued to Noranda for the portion of HR 134 that lies outside the CMW (Patent Number 25-2001-0140). A separate patent was issued to Noranda for the mineral deposits for HR 133 and the portion of HR 134 that lies inside the CMW (Patent Number 25-2001-0141). These two claims straddle the wilderness boundary, and cover 22 acres inside the CMW, for which Noranda received only the rights to the mineral estate with the federal government retaining the surface rights, and 14.5 acres outside the CMW, for which Noranda received fee title (surface and mineral rights). These patented mining claims contain the surface exposure of the ore body proposed for mining by the Montanore Project. The ore body extends north of the patented claims.

In 2002, Noranda terminated the Lease Agreement with Newhi. Pursuant to the terms of that agreement, Noranda conveyed its interest in HR 133 and HR 134 to Newhi. In 2006, Newhi acquired all of the issued and outstanding shares of Noranda. Immediately following the acquisition of Noranda, Noranda's name was changed to Montanore Minerals Corporation (MMC).

1.3.2 Previous Permitting and Approvals

1.3.2.1 General Mine and Transmission Line Approvals

The permitting process for the Montanore Project began in 1989. In that year, Noranda obtained an exploration license from the Montana Department of State Lands (DSL) and other associated permits for construction of an exploration adit from private land in upper Libby Creek. Soon after obtaining the exploration license, Noranda began excavating the Libby Adit. Noranda also submitted a "Petition for Change in Quality of Ambient Waters" (Petition) to the Board of Health and Environmental Sciences (BHES) requesting an increase in the concentration of select constituents in surface and ground water above ambient water quality, as required by Montana's 1971 nondegradation statute. After constructing 14,000 feet of the Libby Adit, Noranda ceased construction in 1991 in response to elevated nitrate concentration in surface water and low metal prices.

Although construction ceased in 1991, the permitting process continued. Specifically, the KNF, the Montana Department of Health and Environmental Sciences (DHES), the Montana Department of Natural Resources and Conservation (DNRC), and the DSL, DEQ's predecessor agency, prepared a Draft, Supplemental Draft, and Final EIS on the proposed project. The environmental review process culminated in 1992 with BHES's issuance of an Order approving Noranda's Petition (BHES 1992) and the DSL's issuance of a Record of Decision (ROD) and DEQ Operating Permit #00150 (DSL 1992) to Noranda. In 1993, the KNF issued its ROD (KNF 1993), the DNRC issued a Certificate of Environmental Compatibility and Public Need under MFSA (DNRC 1993), and the Army Corps of Engineers issued a 404 permit (Corps 1993). These decisions selected mine and transmission line alternatives that allowed for the construction, operation, and reclamation of the project.

1.3.2.2 Water Quality-Related Approvals

The BHES Order, issued to Noranda in 1992, authorized degradation and established nondegradation limits in surface and ground water adjacent to the Montanore Project for discharges from the project (BHES 1992). The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc (both surface and ground water), as well as nitrate (ground water only), and total inorganic nitrogen (surface water only). Pursuant to BHES's Order, these nondegradation limits apply to all surface and ground water affected by the Montanore Project and remain in effect during the operational life of the mine and for so long thereafter as necessary (BHES 1992). The Order also adopted the modification developed in Alternative 3, Option C, of the Final EIS, addressing surface and ground water monitoring, fish tissue analysis, and in-stream biological monitoring. The Order is presented in Appendix A.

The Order also indicates that land application and disposal (LAD) treatment, as then proposed, would satisfy the requirement in ARM 16.20.631(3) (now ARM 17.30.635(3)) to treat industrial wastes using technology that is the best practicable control technology available, or, if such

technology has not been determined by the EPA, then the equivalent of secondary treatment as determined by the DEQ. In 1992, the DHES (now DEQ) determined that LAD treatment, with at least 80 percent removal of nitrogen, would satisfy the requirements of ARM 16.20.631(3). The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved.

In 1997, a Montana Pollutant Discharge Elimination System (MPDES) permit was issued to Noranda by the DEQ (MT-0030279) to allow discharges of water flowing from the Libby Adit to Libby Creek. Three outfalls were included in the permit: Outfall 001 – percolation pond; Outfall 002 – infiltration system of buried pipes; and Outfall 003 – pipeline outlet to Libby Creek. Surface discharge from the adit ceased in 1998 and water in the adit flowed to the underlying ground water.

1.3.2.3 Current Status of Existing Permits

As discussed above, Noranda conveyed its interests in lode claims HR 133 and HR 134 to Newhi in 2002. By that time, many of Noranda's permits for the Montanore Project terminated or expired, such as DEQ's air quality permit, the Corps' 404 permit, KNF's approval, and the State's certification of the transmission line. In 2002, Noranda notified the KNF it was relinquishing the authorization to operate and construct the Montanore Project. Noranda's DEQ Operating Permit #00150 and MPDES permit were not terminated because reclamation of the Libby Adit was not completed.

In 2005, MMI submitted an application for a hard rock operating permit to the DEQ and a proposed Plan of Operations for the proposed Montanore Project to the KNF. MMI also submitted to the DEQ an application for a 230-kV transmission line certificate of compliance, an application for an air quality permit, and an application for a MPDES permit that covered additional discharges not currently permitted under the existing MPDES permit for the Libby Adit.

In 2006, Newhi acquired all of the issued and outstanding shares of Noranda pursuant to the terms of a Stock Transfer Agreement between Noranda Finance, Newhi, and MMI. Although the name of Noranda was changed to Montanore Minerals Corporation (MMC) immediately following Newhi's acquisition of Noranda's shares, MMC (formerly Noranda) remains the holder of DEQ Operating Permit #00150 and the existing MPDES permit for the Montanore Project. Following the acquisition of Noranda, MMI and MMC advised the agencies that MMC will be the owner and operator of the Montanore Project. Consistent with that indication, Newhi has re-conveyed HR 133 and HR 134 to MMC, and MMI and MMC have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC to modify the DEQ Operating Permit #00150 (Klepfer Mining Services 2008a). MMC submitted an updated Plan of Operations to the agencies in 2008 that clarified differences between the 2005 Plan of Operations and DEQ Operating Permit #00150. It also incorporated plans required by DEQ Operating Permit #00150 and additional environmental data collected since 2005 (MMC 2008).

1.3.2.4 Libby Adit Evaluation Drilling Program

In 2006, MMC submitted, and the DEQ approved, two requests for minor revisions to DEQ Operating Permit #00150 (MR 06-001 and MR 06-002). The revisions involved reopening the Libby Adit and re-initiating the evaluation drilling program that Noranda began in 1989. The key elements of the revisions include: excavation of the Libby Adit portal; initiation of water

treatability analyses; installation of ancillary facilities; dewatering of the Libby Adit decline; extension of the current drift; and underground drilling and sample collection. The KNF has not approved any activities at the Libby Adit that may affect National Forest System lands.

Under the revisions, the Libby Adit would be dewatered and water would be treated prior to discharging to one of three MPDES permitted outfalls. The Libby Adit would be rehabilitated and the drift extended 3,300 feet. An additional 7,100 feet including 16 drill stations would be developed under the currently defined ore zones. An estimated 256,000 tons (174,000 cubic yards) of waste rock would be generated and stored at the Libby Adit site.

The evaluation drilling program (MR 06-002) is designed to delineate the first 5 years of planned production. An estimated 35,000 feet of primary drilling and 12,800 feet of infill drilling are planned. The drill core would be used to support resource modeling, mine planning, metallurgical testing, preliminary hydrology assessment, and rock mechanic studies for the full Montanore Project. If adit closure and site reclamation were necessary after completion of the evaluation drilling program, MMC would install a concrete-reinforced hydraulic plug in bedrock, reconstruct the original adit plug, remove all surface facilities, and regrade and revegetate the disturbed areas. Additional information about the evaluation drilling program and site operations and reclamation can be found in MMC's submittal, *Notification to Resume Suspended Exploration and Drilling Activities for the Montanore Project* (MMC 2006), on file with the lead agencies.

1.4 Proposed Action

The 2005 Plan of Operations is considered as a new Plan of Operations by the KNF because Noranda relinquished the federal authorization to construct and operate the Montanore Project in 2002. Both the KNF and the DEQ consider MMC's proposed 230-kV North Miller Creek transmission line to be part of the Proposed Action as the 1993 Certificate of Environmental Compatibility and Public Need for the 230-kV transmission line expired.

As proposed by MMC, the Montanore Project would consist initially of a 12,500-tons-per-day underground mining operation that would expand to a 20,000-tons-per-day rate. The surface mill would be located on National Forest System lands outside of the CMW in the Ramsey Creek drainage. The proposed project also would require constructing about 16 miles of high-voltage electric transmission line from a new substation adjacent to Bonneville Power Administration's (BPA) Noxon-Libby 230-kV Transmission Line to the project site. The Noxon-Libby 230-kV Transmission Line would be looped into the new ring bus substation named the Sedlak Park Substation at the tap point. BPA would design, construct, own, operate, and maintain the substation and loop line, and BPA's customer, Flathead Electric Cooperative, would provide power to MMC at that location. MMC would own and operate the 16-mile-long, 230-kV transmission line from the tap point to the project site. MMC's proposed 230-kV transmission line would be routed from the Sedlak Park Substation along U.S. 2, and then up the Miller Creek drainage to the project site. The location of the proposed project facilities is shown on Figure 2.

The ore body would be accessed from two adits adjacent to the mill. Two other adits, an evaluation/ventilation adit and a ventilation adit, both with entrances located on private land, also would be used during the project. The evaluation/ventilation adit would be located in the upper Libby Creek drainage; the ventilation adit would be located on MMC's private land (patented claim HR 134) in the upper East Fork Rock Creek drainage near Rock Lake.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the surface mill located near the Ramsey Adits. Copper and silver minerals would be removed from the ore by a flotation process. Tailings from the milling process would be transported through a pipeline to a tailings impoundment located in the Little Cherry Creek drainage, about 4 miles from the proposed plant site.

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. (Road names and numbers are used interchangeably in this EIS; a complete list of all road names and numbers is in Appendix B.) MMC would upgrade 11 miles of the Bear Creek Road, and build 1.7 miles of new road between the Little Cherry Creek Impoundment Site and the Ramsey Plant Site. Silver/copper concentrate from the mill would be transported by truck to a rail siding in Libby, Montana. The concentrate would then be shipped by rail to an out-of-state smelting facility.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

As proposed, the mine operating permit area would be 3,628 acres and the disturbance area would be 2,582 acres. The operating permit area would include 443 acres of private land owned by MMC for the proposed mine and associated facilities. All surface disturbances would be outside the CMW. MMC has developed a reclamation plan to reclaim the disturbed areas following the phases associated with evaluation, construction, operation, and mine closure. MMC's proposal is described in section 2.4, *Alternative 2—MMC's Proposed Mine*.

With minor exceptions, MMC proposes to construct, operate, and reclaim a new mine and transmission line in accordance with the terms and conditions of DEQ Operating Permit #00150 and in accordance with the terms and conditions of the other agencies' permits and approvals issued to Noranda in 1992 and 1993. As indicated earlier, MMC and MMI have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC for modification to DEQ Operating Permit #00150, pursuant to ARM 17.24.119(3) (Klepfer Mining Service 2008a). The requested changes to DEQ Operating Permit #00150 are:

- Construction of an additional underground ventilation infrastructure that would result in an acre of disturbance on private land near Rock Lake
- Relocation of the concentrate loadout facility to the Kootenai Business Park located in Libby (private land) resulting in less than 1 acre of disturbance
- Installation of a buried powerline along the Bear Creek Road (NFS road #278), which would be reconstructed for access
- Construction of a temporary electrical substation adjacent to the Ramsey Creek Road (NFS road #4781), which would be reconstructed for access
- A change in the construction technique proposed for the Little Cherry Creek Impoundment from downstream to centerline construction

- Installation of a water pipeline from the Libby Adit to the LAD Areas

Other changes may be required to conform DEQ Operating Permit #00150 to the alternative selected by the KNF on the Montanore Project. MMC and the DEQ agreed to hold the request for modification to the permit in abeyance until completion of the environmental review process.

Each mine and transmission line alternative would require an amendment to the Kootenai Forest Plan (KFP) for the alternative to be consistent with the KFP. The amendment would be completed in accordance with the regulations governing Forest Plan amendments found in 36 CFR 219 and Forest Service Manual 1921.03. The analysis disclosed in this EIS satisfies the requirements for an evaluation for the amendment. The proposed KFP amendments are described in section 2.12, *Forest Plan Amendment*.

1.5 Purpose and Need

The following sections briefly describe the underlying purpose and need to which each major permitting agency (KNF, DEQ, BPA, and Corps) is responding in proposing the alternatives, including the Proposed Action (40 CFR 1502.13). MMC's project purpose and need is discussed in section 1.5.5, *Montanore Minerals Corporation*. Purpose(s) and need(s) are used to define the range of alternatives analyzed in the EIS. Each agency's statutory authorities and policies determine its underlying purpose and need. The KNF's and DEQ's overall purpose and need is to process MMC's Plan of Operations, application for a modification to DEQ Operating Permit #00150, application for a transmission line certificate of compliance, and other permit applications, and to follow all applicable laws, regulations, and policies pertaining to each pending application. The BPA's need is to improve its transmission system to ensure continued reliable electric power to its customers, and its purposes are to minimize costs while meeting BPA's long-term system planning objectives for the area, and to minimize impacts to the human environment through site selection and design.

1.5.1 Kootenai National Forest

As discussed previously, the Forest Service verified in 1985 that valid rights to the minerals patented on HR 133 and HR 134 claims have been established within the CMW. Those rights are currently held by MMC. The role of the KNF under its primary authorities in the Organic Administration Act, Locatable Regulations 36 CFR 228 Subpart A, and the Multiple Use Mining Act is to ensure that mining activities minimize adverse environmental effects on National Forest System lands and comply with all applicable environmental laws. The KNF has no authority to unreasonably circumscribe or prohibit reasonably necessary activities under the General Mining Law that are otherwise lawful. Through the Mining and Mineral Policy Act, Congress has stated it is the continuing policy of the federal government, in the national interest, to foster and encourage private enterprise in:

- The development of economically sound and stable domestic mining, minerals, and metal and mineral reclamation industries
- The orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs

MMC is asserting its right under the General Mining Law to mine the mineral deposit and remove the copper and silver, subject to regulatory laws. From the perspective of the Forest Service, the need is to:

- Respond to MMC's proposed Plan of Operations to develop and mine the Montanore copper and silver deposit
- Ensure the selected alternative would comply with other applicable federal and state laws and regulations
- Ensure the selected alternative, where feasible, would minimize adverse environmental impacts on National Forest System surface resources
- Ensure measures would be included, where practicable, that provide for reclamation of the surface disturbance

1.5.2 U.S. Army Corps of Engineers

In accordance with the Clean Water Act, the Corps is required to consider and express the activity's underlying purpose and need from the applicant's and public's perspectives (33 CFR 325). From the Corps' perspective, the underlying project purpose is to provide copper and silver from deposits contained in northwestern Montana in an economically viable manner to meet a portion of current and future public demands. Over the past decade, global demand for copper and silver generally has been on an upward trend. MMC proposes to mine about 120 million tons of ore at an average grade of 1.93 ounces of silver per ton of ore and 15 pounds of copper per ton. The proposed project would partially fulfill society's demand for these commodities. The following sections discuss the demand and supply for copper and silver.

Because of its properties of thermal and electrical conductivity, malleability, and resistance to corrosion, copper has become a major industrial metal, ranking third after iron and aluminum in terms of quantities consumed. In 2007, building construction was the single largest market for copper, followed by electric and electronic products, transportation equipment, consumer and general products, and industrial machinery and equipment (USGS 2008). Copper byproducts from manufacturing and obsolete copper products are readily recycled and contribute significantly to copper supply. Worldwide use of copper has increased substantially over the past 10 years. World refined copper production was an estimated 15.6 million metric tons in 2007 (USGS 2008), about 4.3 million metric tons more than in 1997 (USGS 1998). The U.S. produced 1.2 million metric tons in 2007. China remained the largest user, which increased copper consumption by 37 percent in the first half of 2007 (USGS 2008).

In 2007, the principal domestic mining states, in descending order of production—Arizona, Utah, New Mexico, Nevada, and Montana—accounted for 99 percent of domestic copper production; copper also was recovered at mines in two other states. The U.S. produced 1.2 million metric tons in 2007, and relied on imports for 37 percent of its copper consumption in 2007 (USGS 2008).

Of all the metals, pure silver has the whitest color, the highest optical reflectivity, and the highest thermal and electrical conductivity. Demand for silver is generated by three primary uses: industrial and decorative uses, photography, and jewelry and silverware. Together, these three categories represent more than 95 percent of annual silver consumption. The dominant use for silver is in industrial applications, which increased worldwide from 319 million troy ounces in 1997 to 430 million troy ounces in 2006. Decreased photographic uses moderated total worldwide

silver demand, which increased from 836 million troy ounces in 1997 to 912 million troy ounces in 2006 (The Silver Institute 2007). The deficit in world silver production was about 26 million troy ounces in 2006 (USGS 2008).

Mine production of silver in the U.S. over the past decade peaked in 1998 at 66 million troy ounces (USGS 2001), decreasing to 37 million troy ounces in 2006 (USGS 2008). In 2007, Alaska and Nevada were the leading U.S. silver producers. The U.S. imported 147 million troy ounces of silver in 2007 (USGS 2008), up significantly from the 107 million troy ounces imported in 1998 (USGS 2001). In 2008, 55 percent of the U.S. silver consumption was met with imports (USGS 2008).

1.5.3 Bonneville Power Administration

The BPA is a federal power marketing agency that owns and operates more than 15,000 circuit miles of transmission lines in the Pacific Northwest. The transmission lines carry most of the high voltage (230-kV and above) from the resources of the federal Columbia River Power system and other interconnected private and federal projects. BPA's customers include publicly owned power marketers (public utility districts), municipalities, investor-owned utilities, and large direct service industries. The utility customers, in turn provide electricity to industry, homes, businesses, and farms.

BPA's transmission system in northwestern Montana provides reliable power to BPA's customers. BPA has a need therefore to improve its transmission system to ensure continued reliable electrical power for all of its customers. BPA's purposes are goals to be achieved while meeting the need for the project; the goals are used to evaluate the alternatives proposed to meet the need. Therefore, BPA will use the following purposes to choose among the alternatives:

- Increase BPA system capacity while maintaining BPA transmission system reliability
- Maintain environmental quality
- Minimize impacts to the human environment through site selection and design
- Minimize costs while meeting BPA's long-term transmission system planning objectives for the area

1.5.4 Montana Department of Environmental Quality

The MEPA and its implementing rules, ARM 17.4.201 *et seq.*, require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project. MMC's project purpose is described in section 1.5.5, *Montanore Minerals Corporation*. Benefits of the proposed project include the production of copper and silver to help meet public demand for these minerals. The project would increase employment and tax payments in the project area. Employment and taxes are addressed in section 3.17, *Social/Economics*. Although the proposed project would help meet public demand for copper and silver, that topic is outside the scope of this EIS and is not addressed in Chapter 3.

The MFSA and an implementing rule, ARM 17.20.920, require that an application for an electric transmission line contains an explanation of the need for the facility. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. As discussed in Chapter 2, the lead agencies

considered, but eliminated from detailed analysis, alternatives other than a new transmission line. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

1.5.5 Montanore Minerals Corporation

MMC's project purpose is to develop and mine the Rock Lake copper and silver deposit by underground mining methods with the expectation of making a profit. MMC's need is to receive all necessary governmental authorizations to construct, operate, and reclaim the proposed Montanore Mine, the associated transmission line, and other incidental facilities. MMC proposes to construct, operate, and reclaim the Montanore Project in an environmentally sound manner, subject to reasonable mitigation measures designed to avoid or minimize environmental impacts to the extent practicable.

1.6 Agency Roles, Responsibilities, and Decisions

Two "lead" agencies have been designated for this project: the KNF and the DEQ. A single Draft EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before construction and operation of the proposed project could begin, various other permits, certificates, licenses, or approvals will be required from the two lead agencies and other agencies (see Table 1 at the end of this chapter). Table 1 is not a comprehensive list of all permits, certificates, or approvals needed, but lists the primary federal, state, and local agencies with permitting responsibilities. The roles and responsibilities of the agencies with primary environmental permitting and regulatory responsibilities are discussed in the following sections.

The major decisions to be made by the lead agencies and by other agencies are discussed briefly in this section. Federal and state agency decision-making is governed by regulations. Each agency's regulations provide the conditions that the project must meet to obtain the necessary permits, approvals, or licenses and provide the conditions under which the agency could deny MMC the necessary permits or approvals.

1.6.1 Federal Agencies

1.6.1.1 Kootenai National Forest

1.6.1.1.1 Applicable Laws and Regulations

Most of the proposed permit areas would be on National Forest System lands managed by the KNF. The KNF is obligated under certain laws, regulations, and 1987 KFP direction to evaluate and take action on MMC's request to operate a mine, mill, and auxiliary facilities on National Forest System lands and associated private lands. The applicable major laws are summarized below:

- The 1872 General Mining Law gives U.S. citizens the right to explore, locate mining claims, make discoveries, patent claims, and develop mines on National Forest System lands open to mineral entry.
- The Organic Act authorizes the KNF to regulate mineral operations on National Forest System lands and to develop mineral regulations at 36 CFR 228, Subpart A. These regulations require that a proposed Plan of Operations be submitted for activities that could result in significant disturbance to surface resources.

- The Multiple Use Mining Act affirms that unpatented mining claims may be used for prospecting, mine processing, and uses reasonably incident thereto.
- The Wilderness Act allows mineral exploration and development under the General Mining Law to occur in wilderness to the same extent as prior to the Wilderness Act until December 31, 1983, when the Wilderness Act withdrew the CMW from mineral entry, subject to valid and existing rights.
- The Alaska National Interest Lands Conservation Act directed the KNF to provide access to non-federally-owned land (which includes patented claims and private mineral estates) within the boundaries of National Forest System lands, allowing landowners reasonable use and enjoyment of their property.
- The KFP management direction is to encourage responsible development of mineral resources in a manner that recognizes national and local needs and provides for economically and environmentally sound exploration, extraction, and reclamation (KFP Vol. 1, II-2, # 11). The objective of the KFP for mining activities is to encourage mineral development under the appropriate laws and regulations and according to the direction established by the plan (KFP Vol. 1, II-8, Locatables).

Forest Service regulations (36 CFR 228, Subpart A) apply to operations conducted under the U.S. mining laws as they affect surface resources on National Forest System lands under the jurisdiction of the Secretary of Agriculture. Operations are defined as all functions, work, and activities in conjunction with prospecting, exploration, development, mining or processing of mineral resources, and all uses reasonably incident thereto, including roads and other means of access on lands subject to the regulation in this part, regardless of whether said operations take place on or off mining claims (36 CFR 228.3(a)). Special use permits may be needed if proposed facilities would not be owned or operated by the operator (MMC) or if facilities would remain in place after mining operations are completed, such as a transmission line, radio facilities, and weather stations. Regulations for special uses on National Forest System lands are contained in 36 CFR 251. Both sets of regulations require that an applicant describe the proposed operation, environmental protection measures, and reclamation plans.

The KNF would share responsibility with the DEQ to monitor and inspect the Montanore Project, and has authority to approve the Plan of Operations that includes all the necessary modifications to ensure that impacts to surface resources would be minimized. The KNF and the DEQ would collect a reclamation bond from MMC to ensure that the lands involved with the mining operation are properly reclaimed. The joint reclamation bond would be held by the DEQ to ensure compliance with the reclamation plan associated with the operating permit and the Plan of Operations, as stipulated in a 1989 Memorandum of Understanding between the Forest Service-Northern Region and the DSL. The KNF may require an additional bond if it determined that the bond held by the DEQ were not adequate to reclaim National Forest System lands or were administratively unavailable to meet KNF requirements. The KNF and the DEQ would collect a reclamation bond for National Forest System lands affected by the transmission line. The DEQ would collect a reclamation bond for private lands affected by the transmission line.

The KNF is required by the National Forest Management Act to provide for the diversity of plant and animal communities. KFP standards for wildlife state that the maintenance of viable populations of existing native and desirable non-native vertebrate species, as monitored through indicator species, will be attained through the maintenance of a diversity of plant communities and habitats. It is Forest Service policy (FSM 2670) that biological evaluations (BE) be

conducted to determine potential effects on sensitive species. If the BE identifies any significant effects that would result in a loss of species viability or create a significant trend toward federal listing, the KNF Supervisor could not issue the permits that would allow the project to proceed.

The KNF is required by the Endangered Species Act (ESA) to ensure that any actions it approves will not jeopardize the continued existence of a threatened or endangered (T&E) species or result in the destruction or adverse modification of critical habitat. The KNF will prepare a biological assessment (BA) that evaluates the potential effect of the proposed project on T&E species, including measures the KNF believes are needed to minimize or compensate for effects. The KNF will submit the BA to the U.S. Fish and Wildlife Service (USFWS) for review and consultation.

Federal agencies have government-to-government responsibilities to consult with federally recognized American Indian Tribes. Among those tribes are the Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho who have retained off reservation treaty rights in the project area through the Hellgate Treaty of 1855. The responsibilities of the KNF regarding tribal consultation are found in the following laws, treaties, and executive orders:

- Hellgate Treaty of 1855
- National Historic Preservation Act
- National Environmental Policy Act
- National Forest Management Act
- American Indian Religious Freedom Act
- Archaeological Resources Protection Act
- Native American Graves Protection and Repatriation Act
- Religious Freedom Restoration Act
- Interior Secretarial Order 3175
- Executive Orders 12866, 12898, 13007, and 13084

1.6.1.1.2 Decision

The KNF Supervisor will issue a decision on MMC's proposal in a ROD. The decision objective is to select an action that meets the legal rights of MMC, while protecting the environment in compliance with applicable laws, regulations, and policy. The KNF Supervisor will use the EIS process to develop the necessary information to make an informed decision as required by 36 CFR 228, Subpart A. Based on the alternatives developed in the EIS, the KNF will issue a ROD in which one of the following decisions will be made:

- Approval of the Plan of Operations as submitted
- Approval of the Plan of Operations with changes, and the incorporation of mitigations and stipulations that meet the mandates of applicable laws, regulations, and policy
- Notification to MMC that the KNF Supervisor will not approve the Plan of Operations until a revision to the proposed Plan of Operations that meets the mandates of applicable laws and regulations is submitted

The alternative selected by the KNF must meet the purpose of the Forest Service locatable mineral surface management regulations as described in 36 CFR 228, Subpart A and the Mining and Minerals Policy Act.

1.6.1.2 U.S. Fish and Wildlife Service

1.6.1.2.1 Applicable Laws and Regulations

The USFWS has responsibilities under the Fish and Wildlife Coordination Act, Endangered Species Act, Migratory Bird Treaty Act, and Bald Eagle Protection Act.

1.6.1.2.2 Decision

The USFWS will decide if implementation of the project would jeopardize the continued existence of any species listed or proposed as T&E under the ESA, or adversely modify critical or proposed critical habitat, based on a BA prepared by the KNF. The USFWS' decision is documented in a Biological Opinion (BO). If the USFWS issues a "jeopardy" or "adversely modify" opinion in the BO, the USFWS would describe reasonable and prudent alternatives, if available, that would avoid jeopardizing the continued existence of T&E species, or adversely modifying critical or proposed critical habitat.

The BO will include "terms and conditions" that MMC must comply with. In addition, the BO will include "conservation recommendations" for discretionary activities to minimize or avoid adverse effects of the Proposed Action on listed species or critical habitat. The USFWS has 135 days from initiation of formal consultation (defined as the acceptance of KNF's BA as complete) to render its BO.

1.6.1.3 U.S. Army Corps of Engineers

1.6.1.3.1 Applicable Laws and Regulations

MMC's construction of certain project facilities in waters of the U.S., including wetlands and other special aquatic sites, would constitute the disposal of dredged or fill materials. Such activities require a permit from the Corps under Section 404 of the Clean Water Act. The Corps will request 401 certification from the DEQ (see section 1.6.2.1, *Montana Department of Environmental Quality*), and has the authority to take reasonable measures to inspect Section 404-permitted activities (33 CFR 326.4).

The Corps and the Environmental Protection Agency (EPA) have developed guidelines to evaluate impacts from the disposal of dredged or fill material on waters of the U.S. and to determine compliance with Section 404 of the Clean Water Act (40 CFR 230). 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. In the guidelines, the term "practicable" is defined as "available or capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." The Corps can only permit the least environmentally damaging, practicable alternative.

1.6.1.3.2 Decision

The Corps will decide whether to issue a 404 permit based on MMC's 404 permit application. MMC will submit a Section 404 permit application to the Corps for the preferred alternative identified by the lead agencies. The application will describe the amount and types of wetlands and other waters of the U.S. that would be affected by proposed facilities. The diversion of Little

Cherry Creek, if a part of the preferred alternative, would be covered by the 404 permit. The permit application also will include detailed plans to mitigate impacts to wetlands and other waters of the U.S. The Corps will issue a ROD on its permit decision. The Corps can deny a Section 404 permit if the project would not comply with the 404(b)(1) guidelines (40 CFR 230.10), or if the permit issuance would be contrary to the public interest (33 CFR 320.4). If the Corps decides to issue a Section 404 permit, it will issue a ROD concurrently with the permit.

1.6.1.4 Bonneville Power Administration

1.6.1.4.1 Applicable Laws and Regulations

A number of federal laws and regulations address open access to BPA's transmission system, including (i) the Bonneville Project Act of 1937, which gives preference and priority in power sales to public bodies and cooperatives; (ii) the Flood Control Act of 1944, which specifies that the Secretary of the Interior (now the Secretary of the Energy) must transmit and dispose of power/energy in a way that encourages widespread use of the power/energy and is sold at the lowest possible rates consistent with sound business principles; (iii) the Pacific Northwest Power Act, which requires BPA "whenever requested" to meet the net requirements of Northwest utilities; and (iv) the Columbia River Transmission System Act of 1974 (the Transmission System Act), which requires the administrator of the BPA to make available to all utilities on a fair and nondiscriminatory basis transmission system capacity not needed to transmit federal power. The BPA would provide a 230-kV power source from its Noxon-Libby 230-kV Transmission Line to its customer Flathead Electric Cooperative at the proposed Sedlak Park Substation. The BPA is prohibited from providing power directly to the project. The BPA would design construct, own, operate, and maintain the substation, which would be paid for by MMC. The substation would be located at Sedlak Park.

1.6.1.4.2 Decision

Before deciding to provide electrical power to Flathead Electric Cooperative for MMC's project, the BPA will prepare a decision document for its part of the project. The BPA can deny approval for the electrical transmission line connection if significant environmental impacts at the connection location would occur, or if the interconnected electrical system would not allow adequate service to the mine and existing electrical customers if the mine were approved.

1.6.1.5 Environmental Protection Agency

The EPA has responsibilities under the Clean Air Act to review Draft EISs and federal actions potentially affecting the quality of the environment. The EPA will evaluate the adequacy of information in this Draft EIS, and the overall environmental impact of the Proposed Action and alternatives. The EPA also reviews 404 permit applications and provides comments to the Corps, and has veto authority under the Clean Water Act for decisions made by the Corps on 404 permit applications. The EPA has oversight responsibility for Clean Water Act programs delegated to and administered by the DEQ. The EPA may also intervene to resolve interstate disputes if discharges of pollutants in an upstream state may affect water quality in a downstream state.

1.6.2 State and County Agencies

1.6.2.1 Montana Department of Environmental Quality

1.6.2.1.1 Applicable Laws and Rules

The Montana legislature has passed statutes and the Board of Environmental Review has adopted administrative rules defining the requirements for construction, operation, and reclamation of a mine and transmission line, discharge of mining waters, discharge of emissions, storage of hazardous and solid wastes, and development and operation of public water supply and sewer systems. The DEQ is required to evaluate the operating permit modification, certificate, and license applications submitted by MMC under the following major laws and regulations:

- MEPA requires the state to conduct an environmental review when making decisions or planning activities that may have a significant impact on the environment. The MEPA and its rules define the process to be followed when preparing an environmental assessment (EA) or an EIS.
- The Montana Metal Mine Reclamation Act (MMRA) requires an approved operating permit for all mining activities that have more than 5 acres of land disturbed and unreclaimed at any one time. The MMRA sets forth reclamation standards for lands disturbed by mining, generally requiring that they be reclaimed to comparable stability and utility as that of adjacent areas. The MMRA describes the process by which a minor revision or a major amendment to an approved operating permit is reviewed and processed. MMC must also obtain the necessary or modify any existing air and water quality permits. Mines that would have more than 75 employees must also have a valid approved Hard Rock Mining Impact Plan prior to operations.
- MFSA requires the DEQ to issue a certificate of compliance before construction of certain major facilities, such as the proposed transmission line. Prior to certification of the proposed transmission line, MMC must also obtain the necessary air and water quality permits.
- The Montana Water Quality Act, through MPDES permits, regulates discharges of pollutants into state surface waters through a permit application process and the adoption of water quality standards. Water quality standards, including the Montana nondegradation policy, specify the changes in surface water or ground water quality that are allowed from a waste water discharge. A MPDES permit may also include limits for discharges of storm water and will require the development of a storm water pollution prevention plan.
- The Clean Air Act of Montana requires a permit for the construction, installation, and operation of equipment or facilities that may cause or contribute to air pollution.
- The federal Clean Water Act requires that applicants for federal permits or licenses for activities that may result in a discharge to state waters obtain certification from the state, certifying the discharge complies with state water quality standards. Section 404 permits issued by the Corps require 401 certification. The DEQ provides Section 401 certification pursuant to state regulations.

- The Montana Public Water Supply Act regulates public water supply and sewer systems that regularly serve at least 25 persons daily for a period of at least 60 calendar days a year. The DEQ must approve plans and specifications for water supply wells in addition to water systems or treatment systems and sewer systems. Operators for community public water supply, waste water treatment, or sewer systems must be certified by the DEQ.
- The Montana Hazardous Waste Act and the Solid Waste Management Act regulate the storage and disposal of solid and hazardous wastes.

1.6.2.1.2 Decision

DEQ's authority to impose modifications or mitigations without the consent of MMC is limited to modifications necessary for compliance with the MMRA, Montana Water Quality Act, Clean Air Act of Montana, or other state environmental regulatory statutes or rules adopted pursuant to those statutes. The DEQ can impose modifications to the proposed transmission line without MMC's consent under MFSA in accordance with 75-20-301, MCA. Grounds for DEQ denial of the application to modify DEQ Operating Permit #00150 would be a finding that the modification does not provide an acceptable method for accomplishing the reclamation required by the MMRA, or that it conflicts with Montana water and air quality laws. The DEQ may deny the application for a transmission line certificate of compliance if the findings required under 75-20-301 cannot be made.

Compliance with MEPA

The DEQ and the KNF have entered into an agreement describing how each agency will cooperate to fulfill the requirements of MEPA and NEPA. No decision is made under MEPA. The Draft EIS is a disclosure document. All DEQ decisions are made pursuant to specific regulatory requirements. The DEQ will issue a ROD or certificate containing its decisions pursuant to each project-related permit application. In general, for an application for an operating permit modification and a transmission line certificate of compliance, three decisions are possible:

- Approval of the application as submitted
- Approval of the application, and the incorporation of mitigations and stipulations that meet the mandates of applicable laws, regulations, and policy
- Denial of the application

Hard Rock Operating Permit

The DEQ Director may make a decision on MMC's application for a modification to DEQ Operating Permit #00150 no sooner than 15 days following publication of the Final EIS. The DEQ may deny the application pursuant to 82-4-351, MCA, if the proposed mine or reclamation plan modification conflicted with the Clean Air Act of Montana, the Montana Water Quality Act, or reclamation standards set forth in the MMRA. The DEQ may also deny the modification based on the compliance standard of an applicant under 82-4-336 and 360, MCA. These sections of the MMRA require permittees to be in compliance at other sites they may have permitted under MMRA, require submittal of ownership and control information, and submittal of an adequate bond.

Transmission Line Certificate of Compliance

For MMC's proposed transmission line, MFSA requires the DEQ Director to determine:

- The basis of the need for the facility
- The nature of the probable environmental impact
- That the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives
- In the case of an electric, gas, or liquid transmission line or aqueduct:
  - What part, if any, of the line or aqueduct will be located underground
  - That the facility is consistent with regional plans for expansion of the appropriate grid of the utility systems serving the state and interconnected utility systems
  - That the facility will serve the interests of utility system economy and reliability
- That the location of the facility as proposed conforms to applicable state and local laws and regulations, except that the DEQ may refuse to apply any local law or regulation if it finds that, as applied to the proposed facility, the law or regulation is unreasonably restrictive in view of the existing technology, of factors of cost or economics, or of the needs of consumers, whether located inside or outside the directly affected government subdivisions
- That the facility will serve the public interest, convenience, and necessity
- That the DEQ or board has issued any necessary air or water quality decision, opinion, order, certification, or permit as required by 75-20-216(3)
- That the use of public lands for location of the facility was evaluated and public lands were selected whenever their use is as economically practicable as the use of private lands

The DEQ requires reclamation of disturbed areas and may require bonds to ensure adequate reclamation. DEQ's decision on the transmission line must be made within 30 days after the final report (Final EIS) is released or may be timed to correspond to the ROD issued by a participating federal agency.

The DEQ must deny certification for a project if the findings in 75-20-301, MCA, or implementing regulations cannot be made or if the transmission line would violate Montana air or water quality standards, based on the DEQ analysis. Without the approval of the mine by the KNF, MMC would likely withdraw the transmission line application because there would not be a demonstrated showing of need for the transmission line. The DEQ may disapprove the transmission line, regardless of actions by other agencies. After issuance of the certificate, any other state or regional agency or municipality or other local government may not require any approval, consent, permit, certificate, or other condition for the construction, operation, or maintenance of a facility except that the DEQ and board retain the authority that they have to determine compliance of the proposed facility with state and federal standards and implementation plans for air and water quality.

Water Quality Permits

MPDES Permit. Waste water discharges, including storm water runoff, from the project site must be included in MMC's current MPDES permit issued by the DEQ. All Montanore facilities must be designed, constructed, and operated to prevent degradation of surface water or ground water

quality beyond that allowed by and specified in the BHES Order (Appendix A). The DEQ will follow EPA Region 8 guidance when determining types of wastewater as “process,” “mine drainage,” or “stormwater.” The DEQ would use both Technology-Based Effluent Limits (TBEL) and Water Quality-Based Effluent Limits (WQBEL) in MPDES permit development or modification. The more stringent of the two, TBEL or WQBEL, would be applied for each specific parameter and would be the final effluent limit for parameters of concern in the discharge. The DEQ must also consider mixing zone applicability and Total Maximum Daily Loads (TMDL) when applicable.

401 Certification. The DEQ has 30 days to review the Corps’ Section 404 permit application and supplemental materials and determine whether to provide a 401 certification (with or without added DEQ conditions), deny the certification, or to request more information. The DEQ may deny the certification if the discharge would result in a violation of Montana water quality standards. The DEQ may also waive certification if the project would cause minimal effects to state waters or it determines that an MPDES permit is required.

318 Exemption (formerly 3A Waiver). A short-term exemption from surface water quality standards for turbidity may be authorized by the DEQ for construction of the powerline, access roads, the tailings impoundment, and other stream crossings (75-5-318, MCA).

Air Quality Permit

The DEQ will decide whether to issue an Air Quality Permit to control particulate emissions of more than 25 tons per year. When an environmental review is completed on the permit application, the final permit or determination may be included in the Final EIS, the ROD, or issued within 180 days after the permit is ruled complete.

Public Water Supply and/or Public Sewer System Authorization

The DEQ will decide on issuance of a public water supply and/or public sewer system authorization. This program is responsible for assuring that the public health is maintained through a safe and adequate supply of drinking water. If the public water supply and/or sewer systems w not constructed within 3 years of authorization, a new application must be submitted.

Hazardous Waste Generator/Transporter Permit

The DEQ has adopted hazardous waste regulations that are equivalent to those promulgated by EPA. The DEQ will decide on issuing a permit for generators and transporters of hazardous waste for the Montanore Project. The permit review considers the applicant’s record of complaints and convictions for the violation of environmental protection laws for 5 years before the date of the application. The DEQ would consider the number and severity of the violations, the culpability and cooperation of the application, and other factors. Annual registration is required.

1.6.2.2 Montana State Historic Preservation Office

The State Historic Preservation Office (SHPO) advises federal and state agencies when a proposed project could affect eligible or potentially eligible historic properties (historic and prehistoric sites). The SHPO provides federal and state agencies with opinions on all historic properties’ eligibility for listing in the National Register of Historic Places. SHPO also provides comments on the determination of effect on eligible historic properties by the Proposed Action The KNF, the DEQ, and the SHPO will concur that the proposed project will have: 1) no effect; 2) no adverse effect; or 3) adverse effect on eligible historic properties. The lead agencies would

require MMC to implement any protection, mitigation, and monitoring in plans reviewed and approved by the SHPO and possibly the Advisory Council on Historic Preservation.

1.6.2.3 Montana Hard Rock Mining Impact Board

The Hard Rock Mining Impact Act (90-6-301 *et seq.*, MCA) is designed to assist local governments in handling financial impacts caused by large-scale mineral development projects. A new mineral development may result in the need for local governments to provide additional services and facilities before mine-related revenues become available. The resulting costs can create a fiscal burden for local taxpayers. The Hard Rock Mining Impact Board (HRMIB), part of the Montana Department of Commerce (DOC), oversees an established process for identifying and mitigating fiscal impacts to local governments through the development of a Hard Rock Mining Impact Plan. Under the Impact Act, each new hard rock mineral development in Montana that would have more than 75 employees is required to prepare a local government fiscal Impact Plan. In the plan, the developer is to identify and commit to pay all increased capital and net operating costs to local government units that will result from the mineral development. A Hard Rock Mining Impact Plan developed for the original Montanore Project was approved in the early 1990s, and that approval was acquired by MMC when it acquired Noranda. Because the Montanore Project as currently proposed would change employment projections, MMC submitted an amendment for consideration by the HRMIB. The HRMIB approved the amendment in 2008.

1.6.2.4 Montana Department of Natural Resources and Conservation

1.6.2.4.1 Applicable Laws and Regulations

The DNRC administers the following statutes and regulations that pertain to MMC's proposed mine and transmission line:

- The Montana Water Use Act requires a water rights permit for the diversion of surface water or use of ground water in excess of 35 gpm or more than 10 acre-feet of water annually.
- Except for the transmission line, the Montana Floodplain and Floodway Management Act requires a permit for new construction within a designated l00-year floodplain.
- A Montana land-use license or easement on navigable waters is required for any project on lands below the low water mark of navigable waters.
- The Streamside Management Zone requirements apply to any landowner or operator conducting a series of forest practices that will access, harvest, or regenerate trees on a defined land area for commercial purposes on private, state, or federal lands. Timber harvest is prohibited within 50 feet of any stream, lake, or other body of water.
- Except for the transmission line, a burning permit must be obtained from the DNRC to burn any slash or other material outside the open burning season of October 10 to November 31 and April 1 to May 31.
- The Conservation Districts Bureau of the DNRC administers the Montana Natural Streambed and Land Preservation Act. Any non-governmental entity that proposes to work in or near a stream on public or private land requires a 310 permit for any activity that physically alters or modifies the bed or banks of a perennially flowing stream.

- The Montana Dam Safety Act applies to the construction, repair, operation, and removal of any dam that impounds 50 acre-feet or more at normal operating pool level. This permit will not apply during mine operation, but may apply after mine closure if other safety criteria are not met.

1.6.2.4.2 Decision

Water Use Permit

The DNRC will decide on issuance of a water use permit based on criteria set forth in 85-2-308, MCA. Denial of the permit must follow 85-2-310 (2), MCA. A person having standing to file an objection may do so pursuant to 85-2-308, MCA. Valid objections received by the DNRC pursuant to 85-2-309, MCA, may require that the DNRC hold a contested case hearing pursuant to 2-4-601 *et al.*, MCA, on the objection within 60 days from a date set by the DNRC. A person who has exhausted all administrative remedies available within the DNRC and who is aggrieved by a final written decision in a contested case is entitled to judicial review pursuant to 2-4-702, MCA.

Floodplain and Floodway Management Permit

The local floodplain administrator or the DNRC would make a decision on the permit application. The application process may take up to 60 days.

DNRC Land Use License or Easement

The DNRC will review the application, conduct a field investigation if necessary, and file an environmental action checklist. A written report and recommendation is then submitted to the Special Use Management Bureau, which makes the final determination and recommends stipulations as necessary. A Land Use License can normally be reviewed, approved, and issued within 60 days upon the payment of the application fee and a minimum annual rental fee set by the DNRC. The license may be held for a maximum period of 10 years, with the ability to request renewal for an additional 10 years. An easement requires approval from the Board of Land Commissioners, which typically takes up to 90 days.

Streamside Management Zone

MMC must comply with the streamside management practices found in 77-5-303, MCA, or submit a request to conduct an alternative practice to the DNRC. Within 10 working days of receipt of the application for approval of alternative practices, the DNRC will determine if the application is approved, approved with modification, disapproved, incomplete, requires additional information or environmental analysis, or requires a field review. If a field review is required, the DNRC will make a decision on the application within 10 days of completing the field review.

Burning Permit

The DNRC Burning Permit outside the open burning season depends on air quality standards set by the DEQ. Review and issuance of the permit is done in coordination with the DEQ and depends on the air quality at the time of the request.

310 Permit

Except for streams associated with the transmission line, the Lincoln County Conservation District of the DNRC must receive a 310 permit application from a non-governmental or private entity prior to activity in or near a perennial-flowing stream. Once an application is accepted, a

team that consists of a conservation district representative, a biologist with the Montana Fish, Wildlife and Parks (FWP), and the applicant may conduct an onsite inspection. The team makes recommendations to the Conservation District Board, which has 60 days from the time the application is accepted to approve, modify, or deny the permit.

High Hazard Dam Permit

DNRC will not be issuing a high hazard dam permit for the tailings impoundment because management and operation of the impoundment would be addressed under an MMRA operating permit during operations. The DEQ intends that MMC's proposed impoundment meet high hazard dam safety requirements including the preparation of an Operations and Maintenance Plan and Emergency Preparedness Plan that meets DNRC requirements, if the impoundment qualifies as such, so that the transition to regulation under DNRC's permit would be facilitated at mine closure.

1.6.2.5 Montana Fish, Wildlife and Parks

The FWP is responsible for the use, enjoyment, and scientific study of the fish in Libby Creek and other project area creeks. FWP's approval, and designation of a licensed collector as field supervisor, would be required for monitoring, mitigation, and transplanting of the fish within the project area. The FWP also administers applicable portions of the Stream Protection Act and cooperates with the DEQ in water quality protection.

The FWP also holds a conservation easement on some lands owned by Plum Creek Timber Company (Plum Creek) where the transmission line may be sited. Under the terms of the conservation easement, the FWP has reserved the right to prevent any inconsistent activity on or use of the land by Plum Creek or other owner and to require the restoration of any areas or features of the land damaged by such activity or use. Activities and uses prohibited or restricted include installing any natural gas or other pipelines or power transmission lines greater than 25-kV unless the prior written approval is given by the FWP.

1.6.2.6 Montana Department of Transportation

The MDT is responsible for the safe operation of the state-owned highways and transportation facilities, such as U.S. 2. The MDT is responsible for approving approach roads onto state-owned highways. MDT is also responsible for approving utilities occupancy within MDT rights-of-way. The MDT reserves the right to modify or deny applications if the design puts the traveling public, the state highway system, or transportation facilities at risk.

1.6.2.7 Lincoln County Weed Board

The Lincoln County Weed Board administers the County Noxious Weed Control Act for any land-disturbing activities within its jurisdiction. MMC is required to submit a weed management plan to the Lincoln County Weed Board for approval.

Table 1. Permits, Licenses, and Approvals Required for the Montanore Project.

Permit, License, or Approval	Purpose
Kootenai National Forest	
Approval of Plan of Operations (36 CFR 228, Subpart A)	To allow MMC to explore, construct and operate a mine and related facilities on National Forest System lands. Approval incorporates management requirements to minimize or eliminate effects on other surface resources that include final design of facilities, and mitigation and monitoring plans as described in the ROD. Review of the proposed plans is coordinated with the DEQ and other appropriate agencies. Approval of the Plan of Operations is contingent on MMC accepting and incorporating the terms and conditions (as listed in the ROD) into the Plan of Operations.
Special Use Permit(s) (36 CFR 251)	To allow utility companies to construct and operate electric transmission/distribution and telephone lines and to allow MMC to construct and maintain associated facilities such as a weather station or radio tower that may remain on National Forest System lands after completion of the mining operation.
Road Use Permit	To specify operation and maintenance responsibilities on National Forest Service roads not covered by the Plan of Operations.
Mineral Material Permit	To allow MMC to take borrow material from National Forest System lands outside mining claims or mill sites.
Timber Sale Contract	To allow MMC to harvest commercial timber from the project area within National Forest System lands. Harvesting would be conducted to clear the area for project facilities.
Approval of Noxious Weed Management Plan	To allow MMC to perform work identified in the Noxious Weed Management Plan to minimize noxious weed propagation.
U.S. Fish and Wildlife Service	
Biological Opinion	To protect T&E species and any designated critical habitat. Consultation with the KNF.
404 Permit Review	To comment on the 404 permit to prevent loss of, or damage to, fish or wildlife resources. Consultation with the Corps.
U.S. Army Corps of Engineers	
404 Permit (Clean Water Act)	To allow discharge of dredged or fill material into wetlands and waters of the U.S. Subject to review by the EPA, the USFWS, the KNF, and the DEQ. Coordinate with the SHPO.

Table 1. Permits, Licenses, and Approvals Required for the Montanore Project (cont'd).

Permit, License or Approval	Purpose
Montana Department of Environmental Quality	
Hard Rock Operating Permit Modification (MMRA)	To allow a change in an approved operating plan. Proposed activities must comply with state environmental standards and criteria. Approval may include stipulations for final design of facilities and monitoring plans. A sufficient reclamation bond must be posted with the DEQ before implementing an operating permit modification. Coordinate with the KNF.
Transmission Line Certificate (MFSA)	To allow the construction and operation of a 230-kV transmission line more than 10 miles long. Reclamation plans and bond can be required. Coordinate with the KNF, the FWP, the Montana Department of Transportation, the DNRC, the DOC, the Montana Department of Revenue, and the Montana Public Service Commission.
Air Quality Permit (Clean Air Act of Montana)	To control particulate emissions of more than 25 tons per year.
MPDES Permit (Montana Water Quality Act)	To establish effluent limits, treatment standards, and other requirements for point source discharges, including storm water discharges to state waters including ground water. Coordinate with the EPA.
Public Water Supply and Sewer Permit	To allow construction of public water supply and sewer system and to protect public health.
Water Quality Waiver of Turbidity (318 Permit) (Montana Water Quality Act)	To allow for short-term increases in surface water turbidity during construction. Request may be forwarded from the FWP.
401 Certification (Clean Water Act)	To ensure that any activity that requires a federal license or permit (such as the Section 404 permit from the Corps) complies with Montana water quality standards.
Hazardous Waste and Solid Waste Registration (various laws)	To ensure safe storage and transport of hazardous materials to and from the site and proper storage and transport and disposal of solid wastes. Some classes of solid waste disposal is covered under the MMRA. Solid wastes may be addressed under the operating permit.

Table 1. Permits, Licenses, and Approvals Required for the Montanore Project (cont'd).

Permit, License or Approval	Purpose
Montana Department of Natural Resources and Conservation	
Water Rights Permit (Montana Water Use Act)	To allow the diversion of surface water or use of ground water in excess of 35 gpm or more than 10 acre-feet of water annually.
Floodplain Development Permit (Montana Floodplain and Floodway Management Act)	To allow construction of project facilities within a 100-year floodplain.
310 Permit (Montana Natural Streambed and Land Preservation Act)	To allow activities that physically alter or modify the bed or banks of a perennially flowing stream.
Streamside Management Zone Law	To control timber harvest activities within at least 50 feet of any stream, lake, or other body of water.
Burning Permit	To control slash or open burning outside the open burning season.
Montana State Historic Preservation Office	
Cultural Resource Clearance (Section 106 Review)	To review and comment on federal compliance with the National Historic Preservation Act.
Montana Fish, Wildlife and Parks	
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. Coordinated with DNRC and the Lincoln County Conservation District. The FWP works with conservation districts to review permit and determine if a Water Quality Waiver of Turbidity (318 Permit) from the DEQ is needed.
Transmission Line Approval	To allow construction of the 230-kV transmission line across the Plum Creek conservation easement.
Montana Department of Transportation	
Approach Permit	To allow safe connection of roads to state highways.
Utility Occupancy and Location Agreement or Encroachment Permit	To allow utility within MDT rights-of-way.
Montana Department of Commerce, Hard Rock Impact Board/Lincoln County	
Fiscal Impact Plan (Hard Rock Mining Impact Act)	To mitigate fiscal impacts on local government services.
Lincoln County Weed District	
Noxious Weed Management Plan	To minimize propagation of noxious weeds.

Chapter 2. Alternatives, Including the Proposed Action

This chapter describes and compares the alternatives considered for the Montanore Project. It includes a detailed description and map of each alternative considered. This chapter presents the alternatives in comparative form, defines the differences between each alternative, and provides a clear basis for choice among options by the decision makers and the public. Because alternative development was in response to issues and concerns identified during scoping, public involvement and the significant issues identified for the project are discussed first. Following a discussion of the key issues, each alternative analyzed in detail is described. MMC's Proposed Action (Mine Alternative 2 and Transmission Line Alternative B) is described in detail. The other action alternatives incorporate many aspects of MMC's proposal and contain less detail. The last section of this chapter discusses the alternatives considered by the lead agencies in developing the alternatives, but that were eliminated from detailed analysis.

2.1 Public Involvement

2.1.1 Scoping Activities

A Notice of Intent (NOI) was published in the *Federal Register* on July 15, 2005. The NOI described KNF's and DEQ's intent to prepare an EIS for the proposed Montanore Project, set the dates for public scoping meetings, and solicited public comments. The NOI asked for public comment on the proposal until September 15, 2005. In addition, as part of the public involvement process, the lead agencies issued press releases, mailed scoping announcements, and held three public meetings. The public scoping meetings were held in Libby and Trout Creek, Montana and Bonners Ferry, Idaho in August 2005. Scoping activities are discussed in the *Scoping Report* (ERO Resources Corp. 2005). A public meeting on the proposed 230-kV transmission line was held in May 2005 to identify resources potentially affected by the proposed transmission line, suggested locations for the proposed line, alternatives to the proposed line, and mitigation measures for the proposed line. At the meeting, MMC presented information on the need for the proposed facility. Consultation and coordination is discussed in Chapter 4.

2.1.2 Issues

Based on the comments received during public scoping, the KNF and the DEQ prepared a Scoping Content Analysis Report that includes a summary of all comments received, organized by resource or issue (KNF and DEQ 2006). The KNF and the DEQ separated the issues into three groups: "key" issues that drove alternative development; "analysis" issues that were used in impact analysis; and non-significant issues. The KNF and the DEQ identified seven key issues; each issue is briefly discussed in the following sections. The indicators, baseline data, and analysis approach used to assess effects on these issues is described in *Issue Statements and Analysis Guidance* (ERO Resources Corp. 2006a), on file in the project record. Each resource section in Chapter 3 describes how the effects on each resource were evaluated.

2.1.2.1 Key Issues

2.1.2.1.1 Issue 1: Potential for acid rock drainage and near neutral pH metal leaching.

Drainage from waste rock, tailings, and storm water runoff may adversely affect water resources in the project area. Effects will be assessed through predicted changes in water quality due to acid generation and near neutral pH metal leaching and release of elevated concentrations of trace elements as a result of weathering of mined materials, based on geochemical characterization data.

2.1.2.1.2 Issue 2: Effects on quality and quantity of surface and ground water resources.

Ground Water Flow and Quality

Underground mining activities may affect ground water in the mine area, which may indirectly affect Rock Lake and other waters in the CMW located above the mine. Discharges to ground water, such as from the proposed LAD Areas and the tailings impoundment, may affect ground water flows and quality. Mine-area effects will be assessed through a two-dimensional model, which will evaluate potential quantity impacts to mine area ground water and overlying and surrounding surface water during construction, operational, and post-mining periods. Effects on ground water at other facility locations will be assessed through estimating changes in flow path, quantity, and quality from discharges.

Surface Water Flow

Changes in ground water from underground mining operations, discharges, and altered topography may change surface water flow and lake levels. Effects will be predicted by evaluating changes in surface water flow in area springs, lakes, and streams. For lower-altitude spring and streamflows, changes will be estimated for mine operation diversions or discharges from or to streams.

Surface Water Quality

Discharges, such as to the LAD Areas or storm water runoff, containing metals, nutrients, and sediments may affect surface water quality in project area lakes, streams, and rivers. Effects will be predicted by estimating changes in selected water quality parameters.

2.1.2.1.3 Issue 3: Effects on fish and other aquatic life and their habitats.

Discharges containing metals, nutrients, and sediments and changes in surface water flows may affect fish and other aquatic life; the threatened bull trout and designated critical habitat in the analysis area are particularly of concern. Riparian habitat alteration from construction and operation of mine and transmission line facilities may affect future attainment of the KFP's Inland Native Fish Strategy (INFS) riparian management objectives (RMOs) for facilities located within riparian habitat conservation areas (RHCAs). The 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.

2.1.2.1.4 Issue 4: Changes in the project area's scenic quality.

The proposed mine and transmission line may change existing scenic quality and visual character of the project area. Effects will be predicted by evaluating compliance with the KFP's visual quality objectives (VQOs). Effects will also be assessed quantitatively by determining mine

facilities and miles of transmission line visible from key observation points, important travel corridors, and the CMW.

2.1.2.1.5 Issue 5: Effects on threatened or endangered wildlife species.

Grizzly Bear

Construction and operation of mine and transmission line facilities may result in the loss of grizzly bear habitat or increase grizzly bear mortality and displacement. Effects will be predicted by estimating changes in percent of core habitat, linear open road density (ORD), percent open motorized route density (OMRD) greater than 1 mile per mile squared (mi/mi^2), percent total motorized route density (TMRD) greater than 2 mi/mi^2, percent habitat effectiveness, and displacement effects in affected Bear Management Units (BMU) in the Cabinet-Yaak Recovery Zone. Effects will also be assessed qualitatively by evaluating potential changes in effectiveness of grizzly bear movement corridors, human activity, and attractant availability.

Lynx

Construction and operation of mine and transmission line facilities may result in the loss or degradation of lynx habitat. Effects would be predicted by estimating percent of lynx habitat in a stand initiation structural stage, regeneration harvest in lynx habitat in the past 10 years, and reduction in snowshoe hare habitat in multi-story mature or late successional forest in affected Lynx Analysis Units (LAU). Effects also would be assessed qualitatively by evaluating connectivity between habitat blocks, habitat for alternative prey, quality of denning habitat, and traffic-related mortality risks in affected LAUs or adjacent LAUs.

2.1.2.1.6 Issue 6: Effects on wildlife and their habitats.

Key Wildlife Habitats

Construction and operation of mine and transmission line facilities may impact the quality or quantity of old growth, snags, and down wood habitat. Effects will be predicted by determining the following:

- Acres of vertical structure removed in designated and undesignated effective and replacement old growth
- Percent of designated old growth in the Planning Subunit (PSU)
- Acres of edge habitat
- Acres of interior old growth
- Estimated percent of potential cavity-nester population by PSU
- Coarse woody debris removed

Forest Service Management Indicator Species – Pileated Woodpecker

Construction and operation of mine and transmission line facilities may remove old growth and impact directly or indirectly cavity-nesting species, such as the pileated woodpecker. Effects will be predicted by determining changes in the estimated number of pileated woodpeckers potentially supported in the analysis area, based on acres of old growth habitat. Availability of down wood and snag habitat and indirect disturbance to pileated woodpeckers will also be evaluated.

2.1.2.1.7 Issue 7: Effects on wetlands and non-wetland waters of the U.S.

Construction and operation of mine and transmission line facilities may affect, directly or indirectly, wetlands and other waters of the U.S. The disturbance may alter wetland function and values. Effects will be predicted by estimating the number of acres filled, dewatered, or otherwise affected. Changes in wetland function and values will be evaluated qualitatively.

2.1.2.2 Analysis Issues

Issues identified by the public and the lead agencies during project scoping not considered as key issues, but important enough to be considered in the effects analysis are listed in Table 2. The lead agencies developed measures to address these issues, where needed to mitigate effects. The indicators, baseline data, and analysis approach used to assess effects on these issues is described in *Issue Statements and Analysis Guidance* (ERO Resources Corp. 2006a), on file in the project record.

Table 2. Other Issues Evaluated in the EIS.

Air Quality	Monitoring	Vegetation
American Indian Consultation	Recreation	Wilderness and Roadless Areas
Cultural Resources	Social/Economics	Migratory Birds
Electro-magnetic Fields and Radio/TV Interference	Soils	Forest Service Indicator Species – Elk and White-tailed Deer
Geology: Subsidence	Sound	Forest Service Indicator Species – Mountain Goat
Geotechnical	Threatened and Endangered Wildlife Species – Gray Wolf	Forest Sensitive Species
Land Use	Transportation	Other Species of Interest – Moose and Montana Sensitive Species

2.1.2.3 Non-Significant Issues

Non-significant issues were identified by the lead agencies as those 1) outside the scope of the Proposed Action; 2) already decided by law, regulation, the KFP, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review…" (Sec. 1506.3).

One issue identified by the public during project scoping, an alternative combining Rock Creek and Montanore Projects, was beyond the scope of this environmental analysis. During scoping, commenters indicated the NEPA process should explore the possibility of an alternative that combines both the Rock Creek and Montanore Projects into one. The Rock Creek Project on the western side of the Cabinet Mountains underwent 14 years of analysis involving agency, tribal, and public participation. A final ROD was issued in 2001 selecting an action alternative. This alternative is discussed in section 2.13, *Alternatives Analysis and Rationale for Alternatives Considered but Eliminated*

2.2 Development of Alternatives

Alternatives were developed based on requirements for alternatives under regulations and rules implementing NEPA, MEPA, MFSA, and Section 404 of the Clean Water Act. Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not analyzed in detail (40 CFR 1502.14). NEPA regulations do not specify the number of alternatives that need to be considered in the EIS, but indicate that a reasonable range of alternatives should be evaluated (40 CFR 1502.14). NEPA regulations require analysis of a No Action Alternative in an EIS. Likewise under MEPA, the DEQ is required to consider alternatives that are realistic, technologically available, and that represent a course of action that bears a logical relationship to the proposal being evaluated (ARM 17.4.603(2)(b)). Alternative alignments for the transmission line were developed based on requirements of MFSA (ARM 17.20.1607).

In addition to satisfying NEPA requirements for the selection of alternatives, projects subject to permitting by the Corps under the Clean Water Act also must comply with the 404(b)(1) Guidelines for discharge of dredged and fill material into wetlands and waters of the U.S. (40 CFR 230). It is anticipated that one or more Montanore Project facilities would need a 404 permit from the Corps. The 404(b)(1) Guidelines specify “no discharge of dredged or fill material shall be permitted 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.” An alternative is considered practicable “if it is available and it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes.” Practicable alternatives under the Guidelines assume that “alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise.” The Guidelines also assume that “all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise” (40 CFR 230.10(3)).

To develop a reasonable range of alternatives, the lead agencies separated the proposed Montanore Project into components. *Components* are discrete activities or facilities (*e.g.*, plant site or tailings impoundment) that, when combined with other components, form an alternative. Options were identified for each component. An *option* is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as thickened tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. Options with more favorable environmental characteristics were retained and other options were eliminated from further analysis. Section 2.13, *Alternatives Analysis and Rationale for Alternatives Considered but Eliminated,* describes the lead agencies’ analysis of alternatives considered but eliminated from detailed analysis. Options comprising the Proposed Action were retained regardless of their environmental characteristics. Next, options for each component were combined into potentially viable alternatives. The transmission line was analyzed as a separate component from the mine facilities because any transmission line alternative could be combined with any mine alternative. Each component or alternative was developed to a level that allowed for comparison of significant environmental issues. If an action alternative were selected in the ROD, final design would be completed after the NEPA process is finished.

The KFP guides all natural resource management activities and establishes management standards for the KNF (USDA Forest Service 1987). The KFP 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, a management area (MA). The Montanore Project is being evaluated under the 1987 KFP. In developing alternatives to the Proposed Action, the lead agencies considered the management direction of the KFP. For example, the KFP, which incorporates INFS standards, establishes stream, wetland, and landslide-prone area protection zones called RHCAs and sets standards and guidelines for managing activities that potentially affect conditions within the RHCAs. An INFS standard for minerals management is to locate structures, support facilities, and roads outside of RHCAs. Where no alternative exists to siting facilities in RHCAs, the standard is to locate and construct facilities in ways that avoid impacts to RHCAs and streams, and adverse effects on inland native fish. Section 2.13.1.1.1, *Inland Native Fish Strategy* discusses that RHCAs were a key resource during the lead agencies' alternatives analysis. The lead agencies did not identify an alternative that would be in compliance with all KFP standards (see section 2.13.2.1, *Forest Plan Consistency*).

The MFSA requires that the proposed transmission line be approved if the findings listed in 75-20-301, MCA and related administrative rules can be made. Under this statute, the DEQ can approve a modified transmission facility or a transmission line alternative different from that proposed by MMC. Under 75-20-301(1)(c), MCA, the DEQ must find and determine that the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives.

Besides the No Action and Proposed Action alternatives for both the mine facilities and transmission line, the lead agencies analyzed in detail two mine alternatives and three transmission line alternatives. The following sections describe these alternatives. In the two mine alternatives and three transmission line alternatives to the Proposed Action, the issues addressed by the modification and mitigations that comprise the alternatives are discussed. The mine alternatives are discussed in the first sections, followed by the transmission line alternatives. The most significant modifications in the alternatives are relocating project facilities, such as the tailings impoundment. These alternative locations are summarized in Table 3. Other mitigations or changes to MMC's proposed mine alternative are listed in Table 4. (A similar table of mitigation proposed for the transmission line is found in Table 32.) Unless modified by the lead agencies, MMC's Mine Proposal as described in Alternative 2 would carry over into the two other mine alternatives. Similarly, aspects of MMC's proposed transmission line alternative, the North Miller Creek Alignment, as described in Alternative B, would carry over into the three other transmission line alternatives, unless modified by the lead agencies. The agencies could select segments from portions of transmission Alternatives B, C, D, or E.

Table 3. Mine Alternative Comparison.

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Operating Permit Areas	3,628 acres	2,606 acres	3,245 acres
Disturbance Areas	2,582 acres	2,011 acres	2,254 acres
Primary Facilities			
Mill site	Ramsey Plant Site in valley bottom in Upper Ramsey Creek	Libby Plant Site between Libby and Ramsey Creek drainages	Same as Alternative 3
Adits and portals	Existing Libby Adit; two Ramsey Adits; Rock Lake Ventilation Adit	Existing Libby Adit; two additional Libby Adits; Rock Lake Ventilation Adit	Same as Alternative 3
Above-ground conveyor	1,200 feet long between Ramsey Adit portal and mill	6,000 and 7,500 feet long (depending on the option) between Libby Adit Site and Libby Plant Site mill	Same as Alternative 3
Tailings impound-ment and seepage collection pond	628 acres in Little Cherry Creek	608 acres between Poorman and Little Cherry creeks	Same as Alternative 2
Perennial stream diversion	Diversion of Little Cherry Creek 10,800 feet long around impoundment to Libby Creek	None	Same as Alternative 2
Land application disposal areas	Two; one along Ramsey Creek and one between Ramsey and Poorman creeks	Two; similar to Alternative 2 with slight boundary modifications	Same as Alternative 3
Water treatment	Land application, Libby Adit Water Treatment Plant, or additional water treatment plant at plant site, as necessary	Same as Alternative 2	Same as Alternative 2

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Primary access road	NFS road #278 (Bear Creek Road) plus new access road; 20 to 29 feet wide	NFS road #278 (Bear Creek Road) plus new access road; 26 feet wide; up to 56 feet wide to accommodate haul traffic and public traffic	Same as Alternative 3
Concentrate loadout location	Kootenai Business Park in Libby	Same as Alternative 2	Same as Alternative 2
Facility Details			
New adits:length, grade, and portal elevation	Ramsey Adits: 16,000 feet long, 8% decline; Elevation: 4,400 feet Rock Lake Ventilation Adit: Elevation: 5,560 feet	Upper Libby Adit: 13,700 feet long, 7% decline; Elevation: 4,100 feet New Libby Adit: 17,000 to 18,500 feet long, depending on option; 5% decline; Elevation: 3,960 feet	Same as Alternative 3
New access roads[†] To Plant Site:	1.7 miles connecting NFS roads #278 and #4781	Existing NFS road #6212 and 4781 used for plant site access	Same as Alternative 2
Realigned NFS road #278 at impoundment	1.8 miles	3.2 miles of new Bear Creek Road connecting existing NFS roads #278 and #4781	Same as Alternative 2
To Adit Portal:	0.3 mile to portal	None	Same as Alternative 3
To LAD Area 1	1.0 mile	0.7 mile	Same as Alternative 3
To LAD Area 2	0.2 mile	0.2 mile	Same as Alternative 3
Pipelines Tailings	Double-walled high-density polyethylene on surface adjacent to access road; 6.4 miles to impoundment	Double-walled buried adjacent to access road; 4.2 miles to impoundment	Same as Alternative 3; 6.4 miles to impoundment
Reclaim water	Double-walled high - density polyethylene on surface adjacent to access road	Double-walled high - density polyethylene buried adjacent to access road	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Tailings pump stations	At Poorman Creek crossing	At each crossing of Ramsey and Poorman creeks	Same as Alternative 3
Borrow areas	Four; 143 acres within impoundment footprint and 419 acres outside of impoundment footprint	Three; 124 acres within impoundment footprint and 92 acres outside of impoundment footprint	Five; 185 acres within impoundment footprint and 252 acres outside of impoundment footprint
Post-mining impoundment runoff	Riprapped channel to Bear Creek	Natural channel to Little Cherry Creek	Riprapped channel to Little Cherry Creek Diversion Channel

[†]Temporary roads within the disturbance area of each facility not listed.

Table 4. Comparison of Mitigation for Mine Alternatives.

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Underground Bulkhead	Not proposed	Maintain one or more underground bulkheasd if hydrologic modeling during initial mine operations (by year 5 of operations) determined that bulkheads would be necessary to minimize changes in East Fork Rock Creek and East Fork Bull River streamflows	Same as Alternative 3
Waste Rock Management Stockpile and Storage	Stored temporarily at unlined stockpile at LAD Area 1, Libby Adit Site, and/or Ramsey Adit portal, or hauled to the tailings impoundment area then used in impoundment dam.	Stored temporarily at stockpiles, lined if necessary, and then hauled to a lined, if necessary, location within impoundment footprint; then used in impoundment dam	Same as Alternative 3
Characterization	Collect representative rock samples from the adits; ore zones; above, below and between the ore zones; and tailings for static and kinetic testing	Same as Alternative 2; in addition, collect samples of the lead barren zone, mineralized alteration haloes within the lower Revett, and the portions of the Burke and Wallace Formations for static and kinetic testing; assess potential for trace metal release from waste rock; conduct operational verification sampling within the Prichard Formation during development of the new adits	Same as Alternative 3
Handling	Segregate potentially acid-generating materials and materials that could create near neutral pH metal leaching as they were mined and placed under sufficient cover to minimize direct exposure to the atmosphere and precipitation	Same as Alternative 2; in addition, segregate potentially acid-generating materials and materials that could create near neutral pH metal leaching from portions of the lower Revett and Prichard Formations for additional kinetic and metal mobility testing and provide for selective handling as indicated by test results	Same as Alternative 3
Geotechnical Testing to Reduce Subsidence Risk	Underground geotechnical investigations would be conducted as the Libby Adit was completed; ongoing subsidence monitoring	Libby Adit evaluation program part of Alternative 3. Testing same as Alternative 2 with the following additions: Install several surface elevation monitoring points over the ore body, working with the lead agencies on the location of these survey sites	Same as Alternative 3.

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
	Not specified	Back-analyze the pillar failure at the Troy Mine using publicly available data to compare the Troy Mine design in effect at the time of the failure with the Montanore design; undertake numerical modeling to further evaluate expected design performance, to assess potential for shear failure at the pillar/roof or pillar/floor interface, and pillar columnization and sill stability between the two ore zones	Same as Alternative 3
	Not specified	Conduct lineament analysis, mapping and statistical analysis of joint frequency and attitude, strain-relief overcoring, and further exploratory drilling	Same as Alternative 3
	Not specified	Complete roof support analyses	Same as Alternative 3
Recreation/Scenery	Not specified	Design and construct a scenic overlook with interpretive signs south of the switchback on NFS road #231 (Libby Creek Road) above Howard Creek with views of the Libby Adit Site	Same as Alternative 3
	Not specified	Fund a volunteer campground host from Memorial Day through Labor Day at Howard Lake campground	Same as Alternative 3
	Not specified	Inspect and maintain access changes used in wildlife mitigation	Same as Alternative 3
Scenery	Not specified	Shield or baffle night lighting at the Libby Adit Site and Libby Plant Site	Same as Alternative 3
	Not specified	Develop final regrading plans for each facility to reduce visual impacts of reclaimed mine facilities	Same as Alternative 3
	Not specified	At the end of operations, place any waste rock not used in construction either back underground or use it in regrading the tailings impoundment	Same as Alternative 3
Waste Management Solid Wastes	Bury certain wastes identified at closure underground in mined-out areas	Disposal of materials underground minimized and identified at closure	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Sanitary Wastes	Closed sanitary system with waste stored in buried sewage tanks; tanks pumped and disposed off-site	Sanitary wastes treated and disinfected on-site and then reused in the mill or discharged at LAD Areas	Same as Alternative 3
Sound	Not specified	Operate all surface and mill equipment so that sound levels do not exceed 55 dBA, measured 250 feet from the mill for continuous periods exceeding an hour	Same as Alternative 3
	Not specified	Adjust intake and exhaust ventilation fans in the Libby Adits so that they generate sounds less than 82 dBA measured 50 feet downwind of the portal	Same as Alternative 3
	Not specified	Use specially designed low-noise fan blades or active noise suppression equipment, if necessary	Same as Alternative 3
Transportation Bear Creek Road Reconstructed Width	20 to 29 feet	26 feet	26 feet; up to 56 feet wide to accommodate haul traffic and public traffic
Other roads	Single lane	Same as Alternative 2, except up to 56 feet wide to accommodate mixed haul traffic and public traffic	Same as Alternative 3
Bear Creek Road south of impoundment	Left in current condition	3.2 miles of new road constructed south of the impoundment for public access; selected segments gravelled	Surface the Bear Creek Road from the new Libby Plant Access Road to the Libby Creek Road with 6 inches of gravel 16 feet wide
Culverts	Install and/or extend culverts	Replace as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows	Same as Alternative 3
Bear Creek Bridge	Not replaced	Replace and widened to a width compatible with a 26-foot wide Bear Creek Road	Same as Alternative 3
Gated roads	Not specified	Install and maintain each closure; gates would have dual-locking devices to allow the KNF fire or administrative access	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Soil Salvage and Handling	Double-lift salvage at Little Cherry Creek Tailings Impoundment, Seepage Collection Pond, Borrow Areas, other potential disturbances within impoumdment area. Single-lift salvage at Little Cherry Creek Diversion Channel, Ramsey Plant Site, Upper Libby Adit Site, LAD Areas, and road disturbances	Double-lift salvage at all disturbances where soil is to be salvaged except road disturbances. These disturbances include Poorman Tailings Impoundment, Seepage Collection Pond, Borrow Areas, other disturbances within impoundment area, Libby Plant Site, Upper Libby Adit Site, and LAD Areas	Similar to Alternative 3, except double-lift salvage at Little Cherry Creek Tailings Impoundment and Little Cherry Creek Diversion Channel
	Not specified	Map soils not mapped at an intensive level at an intensive level prior to salvage to assure maximum amount of suitable soil was salvaged	Same as Alternative 3
	Not specified	Salvage soils at low moisture content to minimize compaction	Same as Alternative 3
Vegetation Removal and Disposition	As proposed in Plan of Operations	Prepare a Vegetation Removal and Disposition Plan for lead agencies' approval	Same as Alternative 3
	Not specified	Where possible, salvage, chip, and use limited amounts of slash as mulch; use large woody debris in fisheries mitigation	Same as Alternative 3
Soil Stockpiles	Stabilize soil stockpiles when they reach their design capacity and seed during the first appropriate season following stockpiling	Incrementally stabilize soil stockpiles (rather than waiting until the design capacity was reached) to reduce erosion and maintain soil biological activity	Same as Alternative 3
	First-lift soils stockpiled together at tailings impoundment	Segregate first-lift soils based on rock content and stockpiled separately at tailings impoundment	Same as Alternative 3
	Second-lift soils stockpiled together at tailings impoundment	Second-lift clay-rich glaciolacustrine soils stockpiled separately from other second-lift subsoils at tailings impoundment	Same as Alternative 3
	For road disturbances, salvaged soils stockpiled along entire road corridors	For road disturbances, salvaged soils stockpiled in clearings or in areas of recent timber harvest immediately adjacent to new roads	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Soil Replacement	Embankment of Little Cherry Creek Tailings Impoundment would be covered with 24 inches of replaced soil using two lifts; rest of impoundment would be covered with 18 inches of replaced soil using two lifts	Entire tailings impoundment would be covered with 24 inches of replaced soil using two lifts	Same as Alternative 3
	Rocky and non-rocky topsoil would be used as upper 9 inches of respread soil on embankment of tailings impoundment	Rocky topsoil would be used as upper 9 inches of respread soil on embankment of tailiings impoundment to minimize erosion	Same as Alternative 3
	Soil would be replaced using single lift at Ramsey Plant Site, Little Cherry Creek Diversion Channel, Libby Adit Site, road disturbances, and other potential disturbances	Soil would be replaced using two lifts at all disturbances requiring soil replacement except road disturbances	Same as Alternative 3, except soil would be replaced in the Little Cherry Creek Diversion Channel
Revegetation Seedbed preparation	Prior to soil replacement, embankment of tailings impoundment would be ripped; top of impoundment would not be ripped	Prior to soil replacement, entire tailings impoundment would be ripped to minimize compaction, break up surface crust and enhance rooting depth	Same as Alternative 3
	Apply organic amendments as needed or when soil tests demonstrate deficiencies	Agency-approved wood-based organic amendment would be incorporated into upper 4 inches of respread soil to improve nutrient content and the organic matter level to 1 percent by volume	Same as Alternative 3
	Use mycorrhizae-inoculated trees and shrubs if readily available	Mycorrhizae would be added to soil in areas where trees are to be planted	Same as Alternative 3
Seed Mixtures	Interim and permanent seed mixtures	Permanent seed mixture only	Same as Alternative 3
	Native and introduced species	Native species only, to the extent they were commercially available	Same as Alternative 3
Tree and Shrub Density After 15 Years	283 trees/acre (assumes a 65 percent survival rate of 435 trees/acre planted) Unspecified (200 shrubs/acre planted)	400 trees/acre 200 shrubs/acre	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Noxious Weeds	No more than 10 percent noxious weeds	Less than 10 percent cover of Category 1 weeds and 0 percent of Category 2 and 3 weeds; would not dominate an area greater than 400 sq ft	Same as Alternative 3
Total Cover	60 percent live vegetation cover or 80 percent of control site total cover	80 percent of control site total cover	Same as Alternative 3
Monitoring Plan	3 consecutive years of success	20 years	Same as Alternative 3
Monitoring			
Ground Water Dependent Ecosystem	Not proposed	Complete a comprehensive ground water-dependent ecosystem inventory an area overlying the proposed underground mine, focusing on areas below about 5,600 feet in the mine area	Same as Alternative 3
	Not proposed	Measure flow of any spring overlying the proposed mine twice, once in early June when the area was initially accessible, and once between mid-August and mid-September	Same as Alternative 3
	Not proposed	Complete a vegetation survey at each identified spring or seep, identify trigger species to monitor effects, develop mitigation for mine-induced adverse effects	Same as Alternative 3
Surface and Ground Water and Aquatic Biology Monitoring	Detailed monitoring around proposed project facilities	Similar to Alternative 2 around project facilities. Additional monitoring in East Fork Rock Creek, East Fork Bull River, Rock Lake, and Libby Lakes Analyze additional parameters, such as chlorophyll *a* and acrylamide Install an array of small-diameter boreholes from, and continuous recording pressure transducers within the mine and adits as construction progressed	Same as Alternative 3
Aquatic Habitat in Little Cherry Creek Diversion Channel	Not specified	None needed	Habitat surveys in diverted Little Cherry Creek every 2 years

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Long-term Maintenance of Little Cherry Creek Diversion Channel	Not specified	None needed	Fund a long-term maintenance account
Mitigation Plans			
Fisheries Fish loss in diverted creeks	Collect all fish in Little Cherry Creek and move the fish to the newly constructed diversion channel	None needed	Same as Alternative 2
	Implement mitigation projects to mitigate fisheries loss	Complete habitat inventory in East Fork Bull River; develop instream structures in East Fork Bull River, Libby Creek, Ramsey Creek, and Poorman Creek	Same as Alternative 3
Sediment	Optional inventory and implementation of sediment abatement projects	Identify existing sediment sources in Libby Creek drainage and implement sediment abatement and instream stabilization	Same as Alternative 3
Wildlife (see Table 32 for additional mitigation for transmission line)			
Old Growth	Not specified	Designate 404 acres of effective or replacement old growth on National Forest System lands	Designate 356 acres of effective or replacement old growth on National Forest System lands
Snags (Cavity Habitat)	Not specified	Leave snags in disturbance areas, such as LAD Areas, unless required to be removed for safety reasons	Same as Alternative 3
Big Game Security	Not specified	KNF to place barriers on five roads year-long: NFS road #4776B Horse Mountain (2.8 miles); NFS road #6205D Big Hoodoo (4.0 miles); NFS road #6209E Crazyman Creek (1.1 mile); NFS road #6787B Hoodoo Bear (1.6 mile); and NFS road #14442 Lampton Pond (0.6 mile)	Same as Alternative 3
Mountain Goat	Not specified	Fund aerial surveys three times annually	Same as Alternative 3
	Not specified	No blasting at adit portals from June 1 to June 30	Same as Alternative 3

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Forest Sensitive Birds and State Bird Species of Concern	Not specified	Complete surveys to locate active nests in appropriate habitat and avoid during nesting, or not remove vegetation in the nesting season	Same as Alternative 3
Migratory Birds	Not specified	Fund or conduct monitoring of landbird populations annually on two, standard Region One monitoring transects within the Crazy and Silverfish PSUs	Same as Alternative 3
Grizzly Bear Road and Trail Access Changes Prior to Libby Adit evaluation program	None proposed	Seasonally change access of (install gates) 6 roads totalling 14.5 miles. Decommission or place into intermittent stored service 13 roads totalling 20.3 miles	Same as Alternative 3
Prior to Montanore Project construction	NFS road #4784 (upper Bear Creek Road) year-long for the life of the project NFS road #4724 (South Fork Miller Creek) on a seasonal basis (April 1 to June 30) for the life of the project	Decommision or place into intermittent stored service 6 roads totalling between 9.6 and 11 miles. Convert trail #935 in upper Rock Creek to non-motorized access	Same as Alternative 3
Land Acquisition for Physical Disturbance	Purchase 2,826 acres of private lands in the Cabinet-Yaak Ecosystem	Secure or protect replacement grizzly bear habitat (through conservation easement, including motorized route access changes or acquisition) of between 3,995 and 4,002 acres (depending on the transmission line alternative) of private lands in the Cabinet-Yaak Ecosystem and a 5-acre parcel near Rock Lake Meadows below Rock Lake	Same as Alternative 3 except protected habitat would be between 4,467 and 4,474 acres (depending on the transmission line alternative) of private lands in the Cabinet-Yaak Ecosystem and the 5-acre Rock Lake parcel
Habitat Enhancement for Reduced Habitat Effectiveness	Not specified	Enhance grizzly bear habitat on between 7,449 and 8,014 acres (depending on the transmission line alternative) of private lands in the Cabinet-Yaak Ecosystem	Enhance grizzly bear habitat on between 7,758 and 8,323 acres (depending on the transmission line alternative) of private lands in the Cabinet-Yaak Ecosystem

Project Facility or Feature	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Personnel Funding	Fund two new full-time wildlife positions, a law enforcement officer, and an information and education specialist	Fund three new full-time wildlife positions, a law enforcement officer before evaluation phase, an information and education specialist, and a bear specialist during construction and operation phases	Same as Alternative 3
Other Measures	Not specified	Fund 100 bear-resistant garbage containers plus an additional 20 per year, after the first year of construction phase, for distribution to the community Fund fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem Fund an initial 10 electric fencing kits for use at bear problem sites that can be installed by FWP bear specialists, and then 2 replacements per year	Same as Alternative 3
Wetlands Mitigation Ratios—Jurisdictional Wetlands	Forested and herbaceous wetlands on a 2:1 ratio; shrub wetland on a 1:1 ratio	Ratios based on type of mitigation: created wetlands credited on a 2:1 ratio, restored wetlands credited on a 1.5:1 ratio	Same as Alternative 3
Mitigation of Non-jurisdictional Wetlands	Not proposed	On a 1:1 ratio	Same as Alternative 3
Wetland Soil Management	Not specified	Wetland soils and sod salvaged and used at mitigation sites	Same as Alternative 3
Pre-construction Hydrologic Monitoring of Mitigation Sites	Not specified	Six months (April–September) of monthly monitoring prior to development of sites	Same as Alternative 3

2.3 Alternative 1—No Action, No Mine

In this alternative, MMC would not develop the Montanore Project, although it is approved under DEQ Operating Permit #00150. The Montanore Project, as proposed, cannot be implemented without a corresponding Forest Service approval of a Plan of Operations. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the mine or a transmission line. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the Forest Service could select the No Action Alternative or the DEQ deny MMC's applications for MPDES and air quality permits, transmission line certificate, and MMC's operating permit modifications are described in section 1.6, *Agency Roles, Responsibilities, and Decisions*.

2.4 Alternative 2—MMC's Proposed Mine

2.4.1 Construction Phase

2.4.1.1 Permit and Disturbance Areas

Development of the Montanore Project would require construction of an underground mine and adits (underground access), and surface facilities, such as a mill, tailings impoundment, and access roads (Figure 2). In MMC's proposal, the mill and mine production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile from the CMW boundary. An additional adit on private land owned by MMC in the Libby Creek drainage and a ventilation adit on private land owned by MMC east of Rock Lake would be used for exploration and ventilation. A tailings impoundment is proposed to be constructed in the Little Cherry Creek drainage, and would require the permanent diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek are proposed to allow for discharge of water to the surface. A portion of the waste rock may be stored temporarily at LAD Area 1 and at the Libby Adit Site. Permit area boundaries would be established around each of these facilities (Figure 3). The total operating permit area would total 3,628 acres and the total permitted disturbance area would be 2,582 acres (Figure 3, Table 5). MMC would upgrade NFS roads #278 (Bear Creek Road) and #4781 (Ramsey Creek Road); short segments of these roads would be realigned. For analysis purposes, the lead agencies used a disturbance area to assess affects on surface resources. For maximum flexibility, MMC would bond to cover the full disturbance area even if no proposed activities were planned. This would allow MMC to construct temporary and seasonal roads and other facilities within these disturbance area boundaries as needed.

The underground mine would produce up to 20,000 tons of ore daily, or 7 million tons per year at full production. Currently delineated mineral resources, estimated at about 135 million tons, extend from Rock Lake to St. Paul Lake beneath the CMW (Figure 4). These estimates are based on a limited number of drill holes. The deposit has not been fully delineated and likely extends farther north than the available drilling information. Considering an expected ore extraction of 65 to 75 percent, waste rock dilution, and initial production rates, the mine is anticipated to have a production life of about 16 years. Three additional years may be needed to mine 120 million tons.

Table 5. Mine Surface Area Disturbance and Operating Permit Areas, Alternative 2.

Facility	Disturbance Area (acres)	Permit Area (acres)
Existing Libby Adit Site	22	219
Rock Lake Ventilation Adit	1	1
Ramsey Plant Site and Adits	52	185
Little Cherry Creek Tailings Impoundment	1,928	2,458
Little Cherry Creek Tailings Impoundment and Seepage Collection Pond	628	
Borrow areas outside impoundment footprint	419	
Soil stockpiles	53	
Other potential disturbance (Diversion Channel, roads, storage areas)	828	
LAD Area 1 and Waste Rock Stockpile	247	261
LAD Area 2	183	226
Access Roads[†]		
Bear Creek Road (NFS road #278 from U.S. 2 to Tailings Impoundment)[§]	79	10
Tailings Impoundment permit area to Ramsey Plant Site (NFS road #278 to new haul road to NFS road #4781)	48	172
Libby Adit Site (NFS road #2316 and #6210) to Ramsey Creek Road (NFS road #4781)	22	96
Total	2,582	3,628

[†]Disturbance area shown for roads excludes 33 feet of existing disturbance along roads.
[§]A small area of the Bear Creek Road would be within a permit area outside of the Little Cherry Creek Tailings Impoundment permit area (Figure 3).

MMC's proposed construction, operation, mitigation, and reclamation plans for the mine are described in the following sections.

A 230-kV transmission line to supply electrical power would be built from the Sedlak Park Substation to the Ramsey Plant Site. Facilities associated with MMC's proposed transmission line are discussed in section 2.8, *Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alignment Alternative)*.

During the construction phase, MMC would construct the Ramsey Plant Site (Figure 5), two Ramsey Adits, and a Ventilation Adit near Rock Lake (Figure 4), tailings impoundment dams, transmission line, and other ancillary infrastructure necessary to initiate mining activities. Construction of a ventilation adit near Rock Lake (Figure 4) may be deferred until initial mine production commended, depending on ventilation requirements. MMC also would undertake underground delineation drilling in the ore body. MMC also would develop the Libby Loadout Facility at the Kootenai Business Park in Libby for concentration storage and shipping. The Libby Loadout Facility is discussed in section 2.4.2.2.2, *Concentrate Shipment*.

U.S. 2 south of Libby to the Bear Creek Road and the Bear Creek Road (NFS road #278) would be the primary access to the mine site. During the construction phase, the Bear Creek Road would be widened and surfaced with chip-seal. MMC would use the Libby Creek Road (NFS road #231) during reconstruction of the Bear Creek Road. MMC's road use for the project is discussed in section 2.4.2.7, *Transportation and Access*.

2.4.1.2 Vegetation Clearing and Soils Salvage and Handling

Prior to any construction, vegetation would be cleared and suitable soils salvaged. Merchantable timber would be measured, purchased from the KNF, and then cleared before soil removal. Non-merchantable trees, shrubs, and slash would be removed using a brush blade to minimize soil accumulation, piled into windrows, and burned. All requirements of the Montana Slash Disposal Law would be observed.

MMC would salvage and replace soils on most disturbed areas, except where slopes were too steep or where the water table was high. Proposed salvaged depths would vary between 9 and 65 inches, based on physical and chemical data collected during the baseline soils survey. Certain soils on a portion of the tailings impoundment would be salvaged in two lifts. The surface layer would be salvaged in other disturbances.

Soil stockpiles would be located in areas to minimize impacts from wind and water erosion, impacts from ongoing operations, and away from sensitive areas (*i.e.*, wetlands and streams) (Figure 6, Figure 7, and Figure 8). If necessary, stockpile locations would be modified to meet field conditions and accommodate quantities of soils actually salvaged. Soils with more than 50 percent rock fragments generally would not be salvaged. Soils with rock fragment contents up to 60 percent by volume would be salvaged in some areas to provide erosion protection on the tailings impoundment dam and portal patio slopes. Reclamation soil thicknesses would be adjusted, if necessary, according to results of interim reclamation and site-specific conditions, as determined by the lead agencies.

Soil would be salvaged and replaced without stockpiling when feasible, primarily at the tailings impoundment, or stockpiled as close as possible to redistribution sites. Active soil stockpiles would be protected to minimize wind and water erosion. Soil stockpiles would be constructed with 40 percent side slopes and 33 percent sloping ramps where possible. As stockpiles reached their design capacity, they would be stabilized and seeded during the first appropriate season following stockpiling. Fertilizer, mulch, and tackifier would be applied as necessary to promote soil stabilization and successful revegetation. Weed control would be an important aspect of the soil storage and protection. MMC's Weed Control Plan describes the measures that would be employed to minimize noxious weeds.

2.4.1.3 Ramsey Plant Site and Adits

MMC would build a plant adjacent to Ramsey Creek (Figure 5), consisting of the following facilities:

- Mill and administration building and associated parking
- Tailings thickener tank
- Mine/yard pond
- Coarse ore stockpile building

- Warehouse
- Explosives storage
- Electrical substation
- Other miscellaneous facilities

Two parallel, 16,000-foot-long production adits would be excavated directly southwest of the Ramsey Plant Site (Figure 4). One adit would serve as the main conveyor adit for ore extraction and an exhaust airway. The other adit would provide an intake for fresh air underground and access for personnel and materials during operations. The adit portals would be outside the CMW boundary. Portal patios, which are flat working surfaces outside the adits, would be constructed by cutting into the sideslope, creating a vertical face for adit construction and an area for staging of supplies. Each adit would be about 30 feet wide by 30 feet high. During adit construction, a lined retention pond would be constructed at the Ramsey Plant Site to handle water during construction of the Ramsey Adits. Water would report to this pond from the adits. A pipeline would be installed to convey water to LAD Areas. The pond would provide storage of 62 acre-feet of water (1 week's storage for a temporary adit discharge of 2,000 gallons per minute (gpm)). After the Starter Dam was built at the impoundment site (see section 2.4.1.5, *Tailings Impoundment*), water would be diverted to the impoundment area for storage and mill startup. The pond would then be enlarged and relined, once storage at the tailings impoundment were available, to the final size required for operations (shown as the mine/yard pond on Figure 5). The pond would be available for use during construction and would provide additional storage capacity/surge storage during mill start-up and other periods.

Underground development would include excavation of a crusher station and related ore and waste rock bins, and development of main mining benches, haulage drifts, and ore and waste passes. At the terminal end of the Ramsey Adits, MMC would build an underground primary rock crusher. MMC anticipates construction of the Ramsey Adits that would connect with the Libby Adit to the crusher station would begin about 6 months after project inception and take about 12 months. The Ramsey Adits would decline to the ore body at an 8 percent slope. MMC would construct the Ramsey Adits from both the surface at the Ramsey Creek portal and underground from the Libby Adit Site.

MMC would excavate a ventilation raise, the Rock Lake Ventilation Adit, beginning vertically from the center of the ore body and then horizontally to private land 800 feet east and 600 feet higher than Rock Lake (Figure 4). Air would be drawn into the ventilation raise to supply fresh air for underground workers. No fans or other facilities are proposed on the surface. The Rock Lake Ventilation Adit would be a combination of a drift from the ore body, a vertical raise, and a short adit to the surface. The portal opening would be about 15 feet wide by 15 feet high and gated with a steel grate or similar structure. The short adit from the vertical raise to the portal would be sloped back into the mine, collecting any water inflow back into the mine. Grouting and other water management techniques would be used to minimize inflow of subsurface water into the raise. The ventilation raise would be constructed from inside the mine and would not require any surface activities, with the exception of creating the surface opening. Total surface disturbance associated with the Rock Lake Ventilation Adit would be about 1 acre. The ventilation adit is not anticipated to be required to support mine construction activities but would be installed during the initial mine production period.

In 2006, MMC received DEQ approval for Minor Revision (MR 06-002) to extend the Libby Adit 3,300 feet to the ore body and to conduct underground evaluation drilling and geotechnical and hydrogeologic studies. The KNF has not approved any activities described in Minor Revision 06-002 that may affect National Forest System lands. MMC would use the Libby Adit Site for ventilation and a secondary escape route for underground workers (Figure 6). If the KNF did not approve the evaluation drilling, it would begin at the start of the project. Additional drilling beyond the evaluation drilling would be completed during the pre-production phase of the project to provide information required for mine planning beyond the first 5 years of production.

2.4.1.4 Waste Rock Management

All waste rock produced during construction and operations would be stored in waste rock stockpiles in the Ramsey Plant Site or LAD Area 1, and then used for tailings embankment construction, Ramsey Plant Site and portal construction, or placed in mined out sections of the mine (Table 6) for ongoing tailings dam construction. During pre-production and possibly during operations, waste rock would be temporarily stored at an unlined area in the LAD Area 1 for future use in dam construction material. Waste rock stored in the LAD Area 1 waste rock stockpile would be no higher than 50 feet above the original ground contours. All waste rock would be removed from the stockpiles by the end of operations. For scheduling and construction reasons, some waste rock generated during adit construction would be stored temporarily near the adits (Libby Adit Site or Ramsey Plant Site). The majority of the waste rock would be directly hauled to LAD Area 1 (Figure 7) or to the tailings impoundment area for dam construction. During operations, waste rock generated that would not be required for the tailings impoundment would be placed in mined out areas underground.

The waste rock sampling plan is described in MMC's waste rock management plan (Geomatrix 2007b). During mining, MMC would collect representative rock samples from the adits; ore zones; above, below, and between the ore zones; and tailings. MMC would conduct static and kinetic testing on these samples to evaluate the acid-producing potential. Acid-base accounting results, total sulfur analyses, and pH measurements would be documented.

Acid-generating materials would be segregated for special handling as they were mined and would be placed under sufficient cover to minimize direct exposure to the atmosphere and precipitation. Such locations could include the inner portions of the tailings dam and inside the mine workings. No rock materials would be used for construction before determination of its acid-producing potential. In addition, waste rock generated from the underground barren zone would be minimized, to the extent possible, due to higher lead concentrations present in this rock zone, and the greater potential for acid generation. Barren zone waste rock would be segregated from other waste rock and disposed underground.

All waste rock data would be evaluated with water monitoring data to determine whether any changes in water quality were the result of acid or sulfate production. Annual reports documenting sample location, methodology, detection limits, and testing results would be submitted to the lead agencies. Acid-base accounting results would be correlated with lithology and total sulfur analyses.

Table 6. Estimated Schedule for Waste Rock Production and Disposal.

Project Stage	Tons	Bank Cubic Yards	Disposal Area
Evaluation Drilling	298,000	130,000	Temporary lined storage pile at Libby Adit Site, then to tailings embankment
Pre-production Waste Rock	1,548,000	668,000	Temporary unlined storage pile at both adit sites, then to tailings embankment
Ore	333,000	148,000	Temporary unlined storage pile near the Ramsey Adit portal, then to mill
Initial Production	288,000	128,000	Tailings embankment
Production with Tailings	576,000	256,000	Tailings embankment
	144,000	64,000	Inside mine
Production Only	864,000	384,000	Inside mine
Total Waste Rock	3,718,000	1,630,000	

2.4.1.5 Tailings Impoundment

The proposed tailings impoundment site is 5 miles northeast of the Ramsey Plant Site, in the Little Cherry Creek watershed. The tailings impoundment would consist of several structures: a diversion dam, a starter dam, a main dam, two saddle dams, and a seepage collection system (Figure 8). The tailings impoundment has a design capacity of about 115 to 120 million tons and, at the planned operating period of 16 years, the tailings impoundment would have an excess capacity of an additional 22 million tons, or 3 years of production (Table 7).

Table 7. Daily and Total Tailings Production Estimates.

Time Frame	Daily Production (tons per day)	Total Production (tons)
Years 1-5	12,500	23 million
Years 6-10	17,000	31 million
Years 11-16	20,000	44 million
Years 17-19	20,000	22 million (excess capacity)
Maximum Capacity		120 million

2.4.1.5.1 Diversion Dam and Channel

The initial step in constructing the tailings disposal facility would be the construction of a Diversion Dam and Channel. A permanent diversion dam and channel system would be constructed at the tailings impoundment area to route Little Cherry Creek around the tailings impoundment to an unnamed tributary of Libby Creek (Figure 8).

The Diversion Channel would consist of three main components: an "engineered" upper channel, a middle channel, and a lower channel. Overall length of the Diversion Channel would be 10,800

feet. The upper channel would convey the Probable Maximum Flood (4,250 cubic feet per second (cfs)) around the tailings impoundment. The upper channel would be 3,200 feet long, 40 to 60 feet deep, and 19 feet wide at the bottom. Within the upper channel, a secondary channel would be constructed. The secondary channel would be designed to contain the average annual high flow in the channel. Wetlands along the upper channel would be excavated. Excavated channel material would be used to construct the Diversion Dam and the Starter Dam; any remaining material from the excavation would be used to construct a portion of the South Saddle Dam. Excavated wetland soils may be used in wetland mitigation.

If the bedrock were deeper than anticipated or of poor quality, riprap would be used for erosion protection. The channel foundation would be lined with compacted silty clay/clay to keep surface flows above the riprap. The upper channel would include a 300-foot, stair-stepped chute structure at the channel outlet. This structure, which would be comprised of 3-foot-high gabions, would dissipate flow energy, minimize erosion potential, and increase channel stability. If erosion were observed during or at the end of operations, rockfill bars or gabions would be placed perpendicular to the natural stream channel below the Diversion Channel to provide energy dissipation and protect against erosion.

MMC identified two channels that could be used to convey water from the upper channel to Libby Creek: Channel A and Channel B (Figure 8). Channel A currently is a 6,200-foot long intermittent channel that flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. A larger culvert at NFS road #1408 west of Libby Creek would be installed. Channel B is south of the lower reach of Channel A and is 3,000 feet long. Flow in Channel A normally does not go into Channel B, except possibly during high flow events. A control gate structure would be installed where Channel A and B join to control flow in both channels. A energy dissipater would be constructed at the outlet section of both channels to reduce flow velocity of water entering Libby Creek. MMC identified a variety of measures that may be used to control erosion and sedimentation and to create aquatic habitat (Geomatrix 2006b).

After the upper engineered section of the Diversion Channel was constructed, and improvements to Channels A and B were completed, MMC would construct a Diversion Dam across Little Cherry Creek. The Diversion Dam would initially act as a low water storage dam, which would direct Little Cherry Creek into the Diversion Channel. Initially, the Diversion Dam would be 60 feet high and have a crest elevation of 3,695 feet. The initial dam would have a low permeability center, with general fill in the upstream and downstream outer zones, and riprap on the diversion side to minimize erosion. The slopes would be steep (0.5H:1V) (Figure 9). Immediately before closure of the Diversion Dam, MMC would collect all fish in the existing stream section and move the fish to the newly constructed diversion channel. The old Little Cherry Creek channel below the tailings impoundment would no longer receive surface flows from above the Diversion Dam.

Toward the end of mine operations, when the tailings impoundment elevations would rise above the dam, it would be raised to a height of 83 feet (3,718 feet elevation) in conjunction with the tailings. Raising of the initial dam would be completed using a homogeneous low permeability fill material, with tailings providing support for the tailings impoundment side of the fill.

2.4.1.5.2 Borrow Areas

To supplement materials excavated during Diversion Channel construction, material would be excavated from borrow areas for use in the Starter Dam, North Saddle Dam, Diversion Dam, Diversion Channel, and other facilities. Material requirements and quality would vary by facility. Borrow material also would be required for rip rap, road material, reclamation capping, and other uses. MMC has identified four borrow areas, one within the impoundment area (Borrow Area A) and three west and south of the impoundment area (Borrow Areas B, C, and D), as sources of construction material (Figure 8).

2.4.1.5.3 Starter Dam

After the Diversion Dam and Channel were operational and Little Cherry Creek was diverted, a Starter Dam would be required to establish the initial impoundment area. The Starter Dam would be a 120-foot-high earthfill dam across former Little Cherry Creek, with a 30-foot-wide crest, and slopes of 2.5H:1V above 3,450 feet elevation and 4H:1V below 3,450 feet elevation on both the upstream and downstream sides of the dam (Figure 9). The fill would consist of locally available silt-sand-gravel glacial deposits from borrow areas. Waste rockfill from the underground mine development may also be used in the downstream portion of the dam, depending on the final rock production and construction schedule. The fill would be placed in maximum uncompacted lifts of 1 foot. All boulders larger than 1-foot diameter would be removed from the fill. Any wetlands within the Starter Dam footprint not filled during construction of the seepage collection system (see next section) would be filled with Starter Dam fill material. During Starter Dam construction, a temporary water reclaim/storage pond would be constructed upstream from the Starter Dam to hold water until the Starter Dam was complete.

The upstream portion of the Starter Dam fill would have low permeability material up to an elevation of 3,460 feet to limit seepage losses from the initial startup water pond. Above an elevation of 3,460 feet, seepage control would be provided by a spigotted tailings beach and seepage collection drains.

Soft, clayey material is present beneath the south abutment of the Starter Dam. A portion of the clayey material would be excavated, stored within the disturbance area, most likely borrow areas, and backfilled with compacted fill to act as a "shear key" for stability (Figure 9). A shear key is an area excavated beneath the dam. Up to three shear keys (100 feet long by 35 feet wide) may be required under the final dam footprint. The extent of the glaciolacustrine clay and its strength would be assessed during final design to optimize the location and extent of the shear keys. Other soft, unsuitable materials, such as wetland soils within the footprint of the Starter and Main Dams, would be either excavated and transported as backfill for the borrow areas, or filled with suitable foundation material, such as general fill from borrow areas or Diversion Dam excavation. Final design for management of these types of materials would be submitted to the agencies for approval. A high-density, polyethylene (HDPE) geomembrane liner would be placed beneath the tailings impoundment, up to an elevation of 3,460 feet, and keyed into the low permeability zone of the dam (Figure 8 and Figure 9).

2.4.1.5.4 Seepage Collection

In the 1992 and 1993 RODs and the DEQ Operating Permit #00150, the lead agencies required Noranda to modify the impoundment design to minimize the seepage from the tailings impoundment to the underlying ground water. MMC incorporated this requirement into the current tailings impoundment design. A seepage collection system would collect seepage from in

and around the tailings impoundment. The collection system would consist of a Seepage Collection Dam and pond, underdrains beneath the dams and impoundment, blanket drains beneath the dams (Figure 9), and pumpback well system. The seepage collection system would be constructed concurrently with the Starter Dam.

The impoundment underdrain system would consist of a two main trunk drains, and a series of secondary lateral drains (Figure 8). One of the main drains would follow the former Little Cherry Creek channel. The lateral drains would be spaced 300 feet apart and would be constructed in the old stream channel, adjacent wetlands, and upland areas in the impoundment. The lateral drains would convey water to the main trunk drains, which would then convey water to the Seepage Collection Pond (see below). The lined water storage pond behind the Starter Dam would not have an underdrain system, but the main trunk would pass under the lined area to the toe of the Main Dam. To facilitate the construction of the trunk lines in the former Little Cherry Creek channel, compacted fill material would be placed in the former channel to facilitate the preparation of the main trunk drains. During construction of the seepage collection system, any wetlands uphill of the Main Dam would be filled. All drains would be placed in a geomembrane-lined trench and consist of a core of highly pervious 1- to 4-inch rock wrapped in geotextile and surrounded by sand and gravel filter material. Locally available sand and gravel alluvial material would be used to cover the drains to prevent the fine tailings from piping into the drain materials during operations.

The underdrain system beneath the Starter and Main dams would use the same design as the trunk drains. The majority of the system would be constructed along and in or above the former stream channel alignment. Lateral lines would be installed in the dam footprint and would be tied to the main trunk drains. The former stream channel and connected wetlands would be filled with sand material to provide a sand bedding to meet trunk and lateral drain design specifications. Blanket drains would be used to control the phreatic (water saturation) level within the Starter Dam, Seepage Collection Dam, North Saddle Dam, the South Saddle, and the Diversion Dam. The blanket drains would be placed under the downstream one-third of the dam footprint (Figure 9). Construction of the blanket drains would consist of a 3-foot thick sand filter and a sand/gravel drain.

After the Diversion Dam and Channel were operational and Little Cherry Creek was diverted, a Seepage Collection Pond and Dam would be built across former Little Cherry Creek, about 100 feet downstream of the tailings impoundment. The dam would collect seepage and runoff from the tailings impoundment (Figure 8). The dam would be designed as a homogeneous fill dam with a downstream toe filter/blanket drain. The dam would have 2.5H:1V slopes and a 30-foot-wide crest at an elevation of 3,325 feet (Figure 9). The final elevation of the dam would be controlled by the available storage developed by borrowing material from the interior of the pond. The pond would be lined with clay or a geomembrane to achieve a permeability of less than or equal to 10^{-6} cm/sec. The pond would be designed to hold one week of flow from the underdrain system and runoff from a 100-year/24-hour storm, or 2.6 acre-feet. An emergency spillway would be constructed in the right abutment of the Seepage Collection Dam. Water collected by the Seepage Collection Dam would be piped to the tailings impoundment and returned to the mill for reuse. The reclaim pumping system would be able to pump up to 2,000 gpm back to the impoundment.

MMC has committed to implementing seepage control measures, such as pumpback recovery wells, if required to comply with applicable standards. Seepage pumpback wells could be installed along the downstream toe of the tailings dam. Given the heterogeneity of the foundation

soils, additional wells could be required to ensure that all of the flow paths were intercepted. The wells may require active pumping, depending on the artesian pressures within the wells (Klohn Crippen 2005).

2.4.1.6 Electrical Power

Electrical power required for fans, pumps, mining equipment, and surface construction during the initial preproduction phase would be supplied by two 1,250-kW diesel generators located at the shop building at Libby Adit Site (Figure 6). The generators would be sized to provide sufficient power until the 230-kV transmission line was installed. One generator would be the primary source of power, while the other would provide backup power if needed. A buried 34.5-kV transmission line along Bear Creek Road and the Ramsey Plant Access Road may be installed to replace the generators prior to the installation of the main transmission line. If the buried 34.5-kV line were installed, the generators would be used as standby power during construction operations. Flathead Electrical Cooperative would provide power to MMC.

To provide power to the Libby and Ramsey adit activities, a temporary substation would be installed near the intersection of NFS road #6210 and the Ramsey Plant Site Access Road (Figure 7). If constructed, the 34.5-kV line along Bear Creek Road and the Ramsey Plant Access Road would connect to this substation. Power would be distributed from the temporary substation to the Libby Adit Site and Ramsey Plant Site. For full operations, a 230-kV transmission line would be installed that ties with the Noxon-Libby transmission line near Sedlak Park (Figure 2) to the Ramsey Plant Site Substation (Figure 5). When the Sedlak Park Substation was built and the main 230-kV transmission line (discussed under section 2.8, *Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alignment Alternative)*) was installed, the temporary substation would be relocated to the Ramsey Plant Site. One of the generators on the Libby Adit Site then would be relocated to the Ramsey Plant Site and provide standby power for mine operations, the remaining generator at the Libby Adit Site would no longer be required and would be removed from the site.

2.4.2 Operations Phase

2.4.2.1 Mining

2.4.2.1.1 Ore Body Characteristics

The ore body is composed of two nearly parallel mineralized horizons that range from 14 to 140 feet thick and are separated by an average of 30 feet of waste rock called the barren zone (Figure 10). The average thickness of the lower horizon (the B ore zone) is about 34 feet, while the average thickness of the upper horizon (the B1 ore zone) is about 30 feet. The ore body outcrops near the northern end of Rock Lake, and plunges about 15 degrees to the north and northwest. The ore body may extend farther to the north and northwest. Overburden thickness ranges from 0 feet at the ore outcrop near the northern end of Rock Lake to more than 3,000 feet near St. Paul Lake. The ore consists of quartzite, silty quartzite, and siltite of the lower Revett Formation. Section 3.8.2.1.3, *Geology of Analysis Area* provides a more detailed discussion of the ore body geology. Rock strength tests were conducted on samples collected from drill cores collected in the early 1980s. Data from the test work was used in mine design, pillar sizes, and other important criteria.

2.4.2.1.2 Mining Method

The ore deposit would be mined using conventional room-and-pillar methods, with both diesel and diesel-electric underground equipment. A room-and-pillar method is where some ore is not mined to provide pillars or columns of ore (Figure 10). MMC's preliminary mine design is based on a rigid-pillar approach. Rigid-pillar design means that all the pillars are designed to carry loads in excess of their strength and are designed not to yield. Different pillar types, based on their location within the deposit, are planned to support the overburden ceiling.

Preliminary mine planning has been based on a standard pillar size of 40 feet wide by 60 feet long, laid out in a regular grid basis (Figure 10). Average mining height of 48 feet and a panel width (area between pillars) of 40 feet were assumed for initial mine planning. Until a sill analysis can be conducted, pillars would be aligned between the upper and lower zones. Initial estimates indicate 65 to 75 percent of the mineable reserves would be removed. Actual pillar sizes would vary depending on the ore thickness, overburden thickness, local rock quality, and hydrologic conditions. MMC would develop the final pillar design after the Libby Adit and subsequent underground testing were complete.

As part of the Libby Adit evaluation phase, MMC would conduct additional underground core drilling before developing final mine plans. The drilling would be used to collect detailed information on underground geologic structures, ore thicknesses, ore grades, and hydrology.

Initial mine development would start in the central section of the deposit. Mining would progress generally toward the outcrop area and take 7 to 8 years to reach the upper portion of the deposit near Rock Lake. MMC would stop mining 500 feet from Rock Lake and 100 feet from the Rock Lake fault (Figure 11). It is expected that the Rock Lake Fault varies in structural thickness. Drilling would define the fault zone and establish the starting point for the 100-foot barrier in advance of approaching the buffer zone. Before the final barrier pillar design/location is completed, MMC is not proposing to mine within this 100-foot buffer zone but would conduct hydrologic and geotechnical studies to determine whether closer mining could be safely conducted. The following parameters would be determined by exploratory drilling ahead of development and flow testing:

- Fault location and slope
- Hydraulic conductivities and storage capacities for the fault zone and adjacent transition zones
- Width of the fault and transition zones
- Water pressures in the fault and transition zones

Similar studies would be conducted on the Rock Lake barrier pillar if mining were proposed closer than 500 feet to Rock Lake. These studies would be reviewed by the lead agencies and approval would be required before MMC could mine within a smaller buffer area. Microseismic and conventional monitoring would be used to evaluate long-term stability. Monitoring sensors would be located in operating and abandoned sections of the mine. The sensors would be connected to a continuous monitoring system and would record the size and approximate location of seismic events.

During full production, ore would be hauled from the ore passes to the primary underground crusher using 26- and 50-ton electric haul trucks. Crushed ore would be sent to the ore stockpile

building via a 1,200-foot overland conveyor for further crushing and ore recovery (Figure 5). The conveyor crossing at Ramsey Creek would be completely enclosed to minimize fugitive dust and a secondary containment trough would catch falling rock to prevent ore from falling into Ramsey Creek. Spillage within the conveyor structure would be shoveled onto the belt or removed at clean out points at either end of the structure.

2.4.2.1.3 Geotechnical Monitoring

Geotechnical monitoring would be completed to collect rock mechanic data and geologic information that were pertinent to mine design criteria and employee safety. The geotechnical monitoring program would be an update to geotechnical monitoring procedures and methods specified in DEQ Operating Permit #00150 and the 1993 ROD. The program monitoring would include logging drillholes and mapping of the mine workings and surface features. Rock quality analysis would evaluate fracture and fault frequency, orientation, and other properties, rock strength testing for stress, strain, and strength, and in-situ geomechanical tests. Microseismic monitoring would be used to assess long-term stability. Microseismic monitoring would include installation of sensor stations in operating and abandoned sections of the mine, and continuous monitoring of sensor stations. Stress monitors would be located near or on faults, barrier pillars, sill pillars, and other important structures/features. Data would be compiled, assessed, and reported to the lead agencies in an annual report.

The monitoring plan would be developed as mine activities were initiated during construction. Mapping would be completed as the adits, development, and mining activities progress. Drilling would be completed as part of the delineation drilling program that would occur in advance of mine development and mining. The core would be available to assess fractures, faulting, and establish if the monitoring plan should be modified to include any new features or address any new issue.

2.4.2.2 Milling

2.4.2.2.1 Ore Processing

The mill would operate 7 days per week, 350 days per year for a total processing capacity of 7 million tons per year (20,000 tons of ore per day). Initial production would be 12,500 tons per day (tpd). The milling process would involve five major steps: crushing, grinding, flotation, concentrate dewatering, and tailings storage (see Figure 24 in MMC 2008). Crushing would occur underground while the remaining processes would occur in the mill facility. Reagents added during the flotation process would separate the copper and silver minerals (sulfides) from the host rock (generally quartzite), producing a copper-silver concentrate.

Ore would be processed into a concentrate using a conventional milling process known as froth flotation. In froth flotation milling, finely ground ore is mixed with water and various reagents and air is forced through the mixture in a series of large tanks called flotation cells. Sulfide minerals, such as copper, attach to air bubbles (or froth) that float to the top of the cell and are skimmed off the surface of the flotation cells and collected. Silver is found in its native form and is attached to the sulfide minerals, such as bornite, associated with the ore deposit. Silver would be collected concurrently with the sulfide minerals. Potassium amyl xanthate would be used as the collector and methyl isobutyl carbinol as the frother. These would be the only reagents required for flotation of the Montanore ore minerals. A polyacrylamide flocculant, such as Percol 352, would be used to assist the settling of the concentrate and the fine fraction of the final tailings in their respective thickeners. Percol 352 contains acrylamide, a regulated volatile organic

chemical in Montana. The proposed reagents are the same reagents used at the nearby Troy Mine. Material safety data sheets for the proposed reagents are presented in MMC's Plan of Operations (MMI 2005a, MMC 2008).

The non-mineralized rock, called tailings, which would consist mainly of quartzite, would sink to the bottom of the flotation cells (see section 2.4.2.3, *Tailings Management*). Bench-scale testing of Montanore Project ore and evaluation of the Troy Mine milling process, which processes an ore similar to Montanore ore, indicate that the mill process would operate at a near neutral pH. MMC does not anticipate the need for pH control. Process chemicals may be required periodically for testing, pH modification, or cleaning the flotation circuit and other process circuits in the mill. The flotation process would continue through cleaner flotation cells and would be repeated several times to improve mineral recovery and concentrate quality. After the flotation circuit, the concentrate would be sent to a dewatering system and stored until it was transported to the Libby Loadout (Figure 12) for shipment to the smelter. The concentrate would be the final economic product of the milling process.

2.4.2.2.2 Concentrate Shipment

After dewatering, the concentrate would be stored in a covered building and then loaded into 20-ton, covered, highway trucks by a front-end loader. Truck covers would be used to minimize loss of concentrate. At peak production, about 420 tons of concentrate, or 21 trucks per day, would be trucked daily via NFS road #4781, a new access road (the Ramsey Plant Site Access Road) (Figure 3), NFS road #278 (Bear Creek Road), reconstructed sections of NFS road #278, and U.S. 2 to Libby, and then to an unnamed road accessing the Kootenai Business Park to a loadout facility. The loadout would be next to the Troy Mine loadout.

Concentrates would be stored at the loadout inside an enclosed building with rail access on private land at the Kootenai Business Park in Libby, Montana, (Figure 12) and then shipped via rail to a smelter. For storage and handling of concentrates, a new building would be erected and either an existing concrete pad or a new pad constructed for the building would be used. The facility would be covered to eliminate any precipitation and runoff issues. Trucks would back onto a concrete pad and dump concentrate into the concentrate building. A front-end loader would stack the concentrate in the building for shipping. Rail cars would be loaded by a conveyor belt fed by a front-end loader. Dust control devices would be used during rail loading activities to minimize fugitive dust. The rail car would be located inside an enclosed area to minimize fugitive dust associated with concentrate handling and loading. The openings of the rail car loadout building would be covered with heavy plastic strips or other similar devices. The railroad track would be extended to permit storage of rail cars. Covers for the rail cars would be used to minimize loss of concentrate.

MMC and the Kootenai Business Park have signed a letter of intent to operate the loadout facility. During final design, MMC would finalize this agreement and discuss retention of the facility for future use by the Kootenai Business Park. For purposes of planning, Kootenai Business Park and MMC expect the building would be retained.

2.4.2.3 Tailings Management

2.4.2.3.1 Tailings Pipelines

Tailings from the milling process would be separated at the mill and tailings impoundment into coarse-textured sand (sand tailings) and fine-textured clay (fine tailings) fractions. The sand

fraction and water would flow as a slurry by gravity through a 10-inch diameter double-walled, high-density polyethylene (HDPE) pipe on the surface from the mill 6.4 miles to the tailings impoundment, where the slurry would be sent to cyclone separators (cyclones) for further separation of dam construction material. As a backup, a second sand fraction tailings line from the mill to the impoundment would be used. Fine tailings from the mill would be transported to the tailings impoundment through a 14-inch double-walled, HDPE or equivalent type pipeline. Reclaimed process water would be returned to the mill from the tailings impoundment in a 14-inch to 16-inch HDPE pipe or similar pipe (Figure 13).

The fine tailings would flow to a thickener northeast of the mill (Figure 5). Thickener overflow (water) would be diverted directly back into the process circuit or to the mine/yard pond (see section 2.4.2.4, *Water Use and Management*). All pipelines would be routed in part on the ground surface along the existing road (Figure 3). A pump station would be needed at a low spot near a new Poorman Creek bridge (Figure 13). This pump station also would pump tailings and water to the tailings impoundment to clear the line in the event of a temporary shutdown due to mechanical or power failure.

MMC has designed measures to prevent or mitigate ruptures in the tailings pipelines. MMC would construct a second sand fraction tailings line to use when the first line was in need of repair or replacement. The pipelines would be double-walled and fitted with air release/vacuum valves to ensure consistent flow. An automated leakage sensing system would continuously monitor line operation. If the system detected a leak, the mill and tailings transfer station would shut down. The surface pipelines between the mill and the tailings impoundment would be visually inspected each shift. An additional inspection would take place during scheduled maintenance shutdowns. The pipelines would be routed in a 24-foot-wide flat bottom ditch to contain any leakage from the pipelines. An unlined 6-foot-wide ditch paralleling the entire length of the road and pipelines would intercept any released tailings (Figure 13). Containment and surface water runoff ditches would be constructed with an earthen berm between them. This berm would ensure that in the event of a rupture of the double-walled pipe, all tailings would remain in the ditch and not come in contact with surface waters. A lined flume and trestle would be constructed (Figure 13) where the pipelines would cross Poorman Creek.

2.4.2.3.2 Main Dam and Saddle Dams

The tailings impoundment would consist of four primary structures: Starter Dam (discussed in section 2.4.1.5, *Tailings Impoundment*), Main Dam, North Saddle Dam, and South Saddle Dam (Figure 8). The Main Dam would be a compacted cyclone sand dam constructed by the centerline method to an elevation of 3,718 feet with a crest width of 30 feet, and downstream slope of 4H:1V (Figure 9). It would be constructed over the Starter Dam. The maximum dam height would be 318 feet and the final crest length would be 5,200 feet. The dam would be raised using up to 30 million tons of cyclone underflow (sand tailings) hydraulically placed and compacted in cells. The cyclone overflow (fine tailings) would be discharged in the impoundment to form a tailings beach on the dam face, forcing water away from the dam. If necessary, mine waste rock would be used in dam construction to supplement the volume of cycloned sands.

The sand shell of the dam would be constructed by hydraulic sluicing of the sand into cells oriented parallel to the dam crest. Dikes of sand pushed up by bulldozers would confine the perimeter of the cells. The cells would range between 100 feet to 150 feet wide, up to 400 feet long, and a maximum of 3 feet thick. Cell construction would begin at the toe of the dam and progress back and forth across the dam face until the downstream slice reaches the dam crest. For

each year of construction, sand placement would start at the downstream toe of the dam and be raised up the dam slope to the required crest elevation. Because the final crest elevation would not be achieved until October at the end of each season, each year's dam raise would provide the required storage needed until October of the following year. This would ensure that adequate dam freeboard and tailings storage capacity would be available at all times.

A collection system would be installed at the downstream end of the cells to decant the runoff water and segregated finer tailings out of the cells. The outflow would be carried in a pipeline to the dam toe where the fines would be settled in the Seepage Collection Pond, prior to pumping the water back the tailings facility. When the sand built up at the discharge end of the cells to between 10 feet to 15 feet, the cell deposition would be advanced along the dam slope. The cycle would be repeated when the full length of the dam had been raised 10 feet to 15 feet.

The South Saddle Dam would be a combination of a compacted general fill starter and cycloned sands, and would be constructed in Year 8 (Figure 8). The starter would contain 280,000 cubic yards of general fill. General fill would be excavated from borrow areas within the impoundment area and available mine waste rock. A North Saddle Dam would be constructed of 170,000 cubic yards of compacted general fill material and would be constructed in Year 11 (Figure 8). A blanket filter and drain would be installed under the compact fill on the impoundment side or downstream portion of the North and South Saddle dams.

2.4.2.4 Water Use and Management

2.4.2.4.1 Project Water Requirements

MMC's projected water balance is an estimate of inflows and outflows for various project components (Figure 14). Actual volumes for water balance variables (*e.g.*, mine and adit inflows, precipitation and evaporation, dust suppression) would vary seasonally and annually from the volumes estimated. MMC would maintain a detailed water balance that would be used to monitor water use. MMC developed two balances, one that reflects expected "steady-state" mine and adit inflows into the mine and one that reflects anticipated peak inflows. Steady-state values are expected to be the average inflows over a long period of time (3 years or more). MMC estimates that 800 gpm in the steady-state water balance would flow into the mine and adits in Years 6 through 16; less inflow water (600 gpm) would be available in earlier years. At steady-state conditions, all inflows would be used for mill make-up water. A make-up water supply of up to 200 gpm year-round would be needed to supplement available water supplies under assumed inflows of 800 gpm.

In accordance with DEQ Operating Permit #00150, MMC would notify the lead agencies if long-term surface water withdrawals would be necessary. Ground water withdrawals from alluvial wells also would be covered under these requirements. MMC would modify the aquatic life monitoring plan to take into account such withdrawals. Withdrawals would not proceed until the lead agencies' approval of an updated aquatic life monitoring plan. MMC would not withdraw any surface water for operational use when flows at the point of withdrawal were less than the average annual low flow. In lieu of measured annual low flows, calculated low flows at the point of withdrawal using data from similar drainages, would be acceptable.

A water balance that used peak inflows of 1,200 gpm was developed to assess the need for and effect of discharge of excess water. In the winter, water not required for milling would be directed to the tailings impoundment for storage until the seasonal operation of the LAD Areas would

begin. During the summer months, water inventories would be reduced at the tailings impoundment through consumption and evaporation. If peak inflows of 1,200 gpm occurred year-round during Years 6 through 10, excess inflow (267 gpm) would need to be disposed. MMC proposes that disposal of 534 gpm (two times 267 gpm) over a 6-month period would be required at the LAD Areas (Table 8).

The lead agencies completed a ground water model to estimate mine and adit inflows. The model estimated that at full build out about 450 gpm would flow into the two Ramsey Adits, the Libby Adit, and the mine void (see section 3.10, *Ground Water Hydrology*). If inflows were less than 1,200 gpm on an average annual basis, MMC would discharge less excess water than the 534 gpm (Table 8). To provide a range of potential inflow rates given the uncertainties in hydraulic properties and interconnection of bedrock fractures, the lead agencies are analyzing the effects of both 450 gpm and 1,200 gpm inflows.

Table 8. Average Process Water Balance during Years of Peak Discharge, Alternative 2.

Mine-Related Facility	800 GPM Inflow (gpm)	1,200 GPM Inflow (gpm)
Mine and Adit Inflows		
Total estimated inflows	800	1,200
Discharge to LAD Areas with any necessary treatment	0	267
Net inflow to mill	800	933
Mill Inflow		
Net inflow from mine/adit	800	933
Stored water from tailings impoundment	1,390	1,390
Make-up water	133	0
Subtotal	2,323	2,323
Mill Outflow		
Water transported with tailings	2,314	2,314
Water in concentrate	9	9
Subtotal	2,323	2,323
Tailings Impoundment Inflow		
Precipitation	461	461
Thickener and cyclone under- and overflows	2,315	2,315
Water released from tailings consolidation	281	281
Runoff captured by seepage collection pond	193	193
Runoff captured by tailings impoundment	46	46
Subtotal	3,296	3,296
Tailings Impoundment Outflows		
Dust suppression	80	80
Evaporation	427	427
Water stored in tailings	1,374	1,374
Seepage into ground water	25	25
Water recycled to mill	1,390	1,390
Subtotal	3,296	3,296

Initially, construction activities would focus primarily on completing the Libby Adit if the Libby evaluation program is not approved by the KNF. Currently, MMC is permitted under MPDES

Permit MT0030279 to discharge water from three outfalls at the Libby Adit. If the Montanore Project is approved and after this EIS is completed, MMC could apply for additional discharge locations at the LAD Areas.

MMC proposes that mine and adit water discharged to the LAD Areas would receive treatment through the land application (*i.e.*, mine and adit water would not receive treatment prior to land application). The initial startup of the mill would require a large quantity of water. MMC would store sufficient water during construction to facilitate the mill startup process. The construction of the Starter Dam would be initiated concurrent with the Ramsey Adits development. Untreated water from the Ramsey Adits would be discharged to the lined mine/yard pond at the Ramsey Plant Site, or LAD Area 1 and 2 until the Starter Dam was completed. After the lined pond behind the Starter Dam was built, water from the Ramsey Adits would be conveyed to the lined water reclaim pond behind the Starter Dam until the desired water quantity was achieved. Once this level of water was achieved in the Starter Dam, Ramsey Adit discharges to LAD Areas 1 and 2 for treatment and disposal would resume. MMC would install a water treatment facility at the Ramsey Plant to meet necessary MPDES discharge limits.

During mine operations, the water reclaim pond would be maintained, within the impoundment area, at a minimum capacity of 30 million gallons for water clarification. Pond location would move throughout the life of the tailings impoundment but would remain along the approximate centerline of the tailings impoundment. Initially, the reclaim water pond would be located near the Starter and Main Dams and progress to the west. All lateral drains beneath the reclaim water pond would be underlain by either the geomembrane liner, or tailings before being covered with the reclaim pond. Water from the tailings impoundment would be pumped back to the mill in a 14-to 16-inch diameter, 1-inch-thick double-walled HDPE or similar surface pipeline that would parallel the tailings pipelines. Post-closure water use and management is discussed on page 74.

2.4.2.4.2 Wastewater Discharges

A current MPDES permit (MT0030279) has been issued to MMC for discharges from the Libby Adit Site (Figure 15). The permit allows discharges from three outfalls. The permit became effective April 1, 2006 and expires on March 31, 2011. The permitted outfalls are:

- Outfall 001 – percolation pond
- Outfall 002 – leach field consisting of three infiltration zones
- Outfall 003 – direct discharge via a pipe from the percolation pond to Libby Creek

During operations, MMC would maintain the permitted outfalls at the Libby Adit Site and would apply for additional outfalls for wastewater disposal. Potential wastewater discharges associated with Alternative 2 include:

- Seepage or percolation to ground water from LAD Areas 1 and 2
- Seepage or percolation to ground water from the Little Cherry Creek tailings impoundment)
- Surface water runoff and/or seepage from waste rock stockpile(s) at LAD Area 1
- Surface water runoff from the Ramsey Plant Site and portal

The EPA has established Effluent Limitations Guidelines (ELGs) applicable to mines that produce copper and silver and mills that use the froth-flotation process for the beneficiation of copper and silver (40 CFR 440.100). The following discharges subject to the ELGs would include, but not be limited to: mine and adit drainage, tailings impoundment seepage, tailings impoundment dam runoff, runoff and seepage for waste rock stockpiles, runoff from facilities constructed of waste rock if subjected to precipitation, and runoff of excess water from LAD Areas 1 and 2. The discharges would be regulated at an outfall in a MPDES permit. The following discharges would be subject to Montana's storm water regulations, but not to the ELGs: soil stockpiles, access roads, parking areas, and runoff or seepage of facilities not constructed of waste rock or tailings. Management of stormwater discharges are discussed in the subsequent section 2.4.2.4.4, *Storm Water Control*.

Land Application Disposal

MMC has constructed and operates a filtration treatment plant to treat adit and mine inflows from the Libby Adit. MMC has proposed to use the LAD Areas for treatment and disposal of adit and mine inflow water from the Ramsey Adits. MMC would dispose of adit and mine inflows during construction and operations at LAD Areas 1 and 2 between Ramsey and Poorman creeks (Figure 7) using spray irrigation techniques. As part of the overall water management plan, MMC would construct a water treatment plant if necessary to meet permit conditions established by the lead agencies. Depending on the alternative selected, this may be a separate water treatment plant at the Ramsey Plant Site or use the existing water treatment plant that exists at the Libby Adit.

Concurrent with the Ramsey Adit completion, MMC would construct a 10-acre lined surge pond at LAD Area 1 (Figure 7 and Figure 15). The surge pond would convey water to the spray irrigation system. During construction, mine and adit water from the Libby Adit could be discharged via the existing outfalls 001, 002, and 003 or LAD Area 1. MMC plans to install a pipeline from the Libby Adit area to the LAD Areas.

Wastewater would be disposed of through irrigation of 200 total acres at the two LAD Areas. MMC proposes to operate both LAD Areas concurrently, with the capability of irrigating at a peak rate of 534 gpm (267 gpm annually over 6 or 534 gpm, Table 8). The combined LAD Areas would have a capacity of 2,000 gpm of water during the 6-month growing season. If disposal of higher quantities of water were required due to greater than expected mine dewatering rates, the water would be stored in the tailings impoundment and/or discharged untreated to one or more of the supplemental LAD Areas (see section 2.4.2.4.3, *Excess Water Management*).

Each LAD Area would have above-ground irrigation pipes and sprinklers four to eight feet above the ground surface. The LAD Areas would require selective tree thinning to allow a 50-foot unrestricted spray radius around each sprinkler. Typical operation would cycle all sprinklers once per week and apply about one inch of water per cycle. The maximum application rate per sprinkler would be about 4 inches per month and 24 inches over the 6-month growing season. The average application rate is 0.04 inch per hour; the application rate would vary depending on climate and site-specific conditions. Additional detail about LAD operations is found in MMC's Plan of Operations (MMI 2005a, MMC 2008).

The LAD Areas would be 300 feet or more from any perennial stream (Figure 15). In addition, sprinkler systems would be designed so that areas within 100 feet of ephemeral drainages could be shut off during periods of surface water runoff. MMC is evaluating the option of using snow-making equipment to convert stored water into snow during the winter season. This snow would

be spread over LAD Areas 1 and 2. Snow-making would only be performed after an assessment was completed and approved by the lead agencies regarding potential for excess loading to LAD Areas 1 and 2 during the winter season.

Infiltration and/or runoff from stormwater on the waste rock stockpile at LAD Area 1 is subject to MPDES permitting requirements. MMC proposes to collect LAD Area 1 surface water runoff in an unlined ditch extending northward along NFS road #4781 and routed into an unlined sediment retention pond (Figure 7). A second unlined ditch and pond are proposed for runoff from LAD Area 2. These two ponds would be sized to contain runoff from a 10-year/24-hour storm event. An overflow from either pond is proposed to discharge pipe to Poorman Creek via overland flow. Seepage from unlined ponds would discharge to ground water. To reduce storm water-mine drainage commingling on the LAD Areas, runoff from undisturbed upgradient areas would be diverted around both LAD Areas. LAD Areas 1 and 2 would be used seasonally.

The Waste Rock Stockpile at LAD Area 1 would be a staging area for temporary and intermittent placement of waste rock during construction of the tailings impoundment dams. In addition, MMC anticipates minimal to no surface water discharges from LAD Area ponds due to the design capacity (10-year/24-hour storm event).

Tailings Seepage

As part of the conditions of DEQ Operating Permit #00150, MMC designed an underdrain system to collect tailings water from beneath the tailings impoundment to minimize seepage to underlying ground water (Figure 8). Water collected by the underdrain system would flow beneath the tailings dam, down a short segment of the former Little Cherry Creek, and be captured by the Seepage Collection Dam. MMC estimates 25 gpm of tailings water seepage would not be collected by the underdrains and would discharge to ground water.

Stormwater Runoff from Ramsey Plant Site

The Ramsey Plant Site and adit portal pads would be constructed with a combination of waste rock and native cut-and-fill material. The waste rock at the Ramsey Plant Site would be placed so that it was surrounded by native material, thereby preventing direct contact of surface water runoff with waste rock. Stormwater runoff from the top of the plant site pad area would be directed to a lined mine/yard pond (Figure 5). An unlined sediment trap near the portal area would convey runoff to the lined mine/yard pond. Runoff and seepage from the plant site fill slopes above Ramsey Creek would be collected in ditches and directed to an unlined sediment trap. The sediment trap would be designed to contain runoff from a 10-year/24-hour storm event. Excess water beyond the capacity of the trap would discharge to Ramsey Creek through a constructed discharge point. Seepage to ground water may be considered a discharge to ground water and subject to MPDES permitting requirements. MMC expects that a surface water discharge from the unlined sediment trap would be “intermittent” because, at build-out, most of the surface area of the pad would be covered with impermeable materials and any surface runoff would flow to the lined mine/yard pond. Water from the lined mine/yard pond would be used in the mill as needed. MMC expects a discharge to Ramsey Creek from exposed waste rock would only occur intermittently during construction.

2.4.2.4.3 Excess Water Management

The LAD Areas and tailings impoundment would be the primary wastewater storage and disposal areas. MMC would use a number of techniques for managing project-related inflows and discharges, such as the existing Libby Adit Water Treatment Plant, grouting fractures and joints to

reduce ground water inflows, storage in the tailings impoundment coupled with enhanced evaporation (evaporating water by spray irrigation, either at the tailings impoundment or LAD Areas 1 and 2), and LAD Area/Supplemental LAD Area. These techniques are briefly discussed in the following sections.

Libby Adit Water Treatment Plant

The Libby Adit Water Treatment Plant was designed to remove nitrate and could be used to treat 500 gpm mine and adit water. The existing infrastructure at the Libby Adit Site would allow piping of the water from the Ramsey Adit and mine workings via the Libby Adit. A series of collection sumps would be constructed to remove sediment prior to discharge to the water treatment plant.

Collection and segregation of "clean" ground water from normal mine drainage water in areas where large water inflows occur could reduce the volume of water requiring treatment. The technique involves drilling an array of holes into a water producing zone and directing the water into a collector pipe. The inflowing ground water would be unaffected by mining activities and could be discharged without treatment while maintaining compliance with the discharge permit limits. Segregation of water may be difficult and not practical or feasible. This technique would not affect the water balance, but could reduce the mine water volume needing treatment.

Underground Water Management - Grouting

The bedrock encountered by the adits and mine would have low permeability. Several large faults and many smaller fractures, capable of storing and transmitting ground water, would be encountered during mine development. To reduce the amount of water entering the adits and mining areas, MMC would grout areas where water was flowing into the adits and mine workings. Drilling would occur ahead of drift development to allow identification of potential inflows. Grouting would be used as the primary mechanism to reduce adit and mine inflows.

Tailings Impoundment Storage

An estimated 71 million gallons of water (220 acre-feet) would be required to initiate mill operations, and MMC plans to slowly build this water inventory during construction activities. The lined Starter Dam would be designed to hold the required amount of water for mill startup.

During Starter Dam construction, a temporary water retention structure upstream from the Starter Dam would be constructed to hold water temporarily until the Starter Dam was complete. Once the tailings facility was in full operation, MMC expects there would be ample storage capacity to hold excess water.

Winter Discharge/Supplemental LAD Areas

If necessary, LAD Areas 1 and 2 could be used in the winter months using snowmaking equipment for primary treatment of discharges. This method would be used sparingly as it would delay startup of LAD Areas 1 and 2 in the summer. MMC identified supplemental LAD Areas near the two Ramsey Creek LAD Areas 1 and 2 and the Little Cherry Creek impoundment for discharge of wastewater (Figure 16). Borrow pits at the tailings impoundment would be available for untreated water disposal and are anticipated to be required only to handle excess water or temporary increases in water during construction. If the borrow pits were used for land application, wastewater would be applied at a rate that would increase evaporation and plant consumption of water.

Temporary Diversions

Temporary diversion ditches within the tailings impoundment would be used to control water from undisturbed areas. If additional water were required, precipitation and snowmelt from undisturbed areas within the tailings impoundment could be directed to the tailings impoundment and then pumped back to the mill to meet make-up water requirements. In the event of surplus water, MMC would divert water collected by the temporary diversion ditches within the tailings impoundment, but above the expanding tailings pond. These ditches would divert surface runoff from undisturbed lands within the tailings impoundment perimeter into the Little Cherry Creek diversion, thereby reducing the amount of water entering the tailings impoundment.

Enhanced Evaporation, Infiltration, and Dust Control

Enhanced evaporation would be accomplished by spraying within the tailings impoundment and when land applying untreated water at the LAD Areas. Managing water through a sprinkling system would result in substantial evaporation during certain periods of the year. In addition to evaporation, the LAD Areas would provide infiltration where vegetation would consume some of the water applied. MMC plans to use water to control dust from the tailings beaches. This would consume/evaporate a portion of the water generated from the project.

2.4.2.4.4 Storm Water Control

MMC has developed a Storm Water Management Plan (Geomatrix 2007a). Surface runoff from the Ramsey Plant Site would be mine drainage and would be directed to a collection ditch on the southern side of the Ramsey Plant Site (Figure 5). The water would then flow by gravity to a lined mine/yard pond sized to accommodate the 10-year/24-hour storm event volume (including sediment), 4 hours retention of the thickener overflow, and 3 feet of excess capacity or freeboard as a safety factor. The mine/yard pond would be lined with clay or a geomembrane to achieve a very low permeability (less than or equal to 10^{-6} cm/sec). Excess water in the pond could be used as mill make-up water or disposed at the tailings impoundment or LAD Areas (Table 8). The portal patio surface water would be storm water runoff and would be directed down the access road, through a culvert at the Ramsey Creek bridge toward the mine/yard pond. A unlined sediment trap would be constructed below the portal patio and would be sized to handle a 10-year/24-hour storm event.

A riprapped interceptor ditch would be constructed on the north side of the Ramsey Plant Site to divert surface storm water runoff from undisturbed areas above the mill (Figure 5). The flow would pass through culverts at the main access road and discharge 300 feet from Ramsey Creek.

MMC would be responsible for snow removal from all access roads and the Ramsey Plant Site. All snow and ice removed from the site would be deposited according to mine drainage water management plans, including being left at the Ramsey Plant Site or Libby Adit Site or hauled to LAD Areas 1 and 2 or tailings impoundment. All debris removed from the road surfaces except snow and ice would be deposited away from the stream channels. Snow removal would be conducted in a manner to minimize damage to travelways, prevent erosion damage, and preserve water quality. Culverts would be kept free of snow, ice, and debris. MMC would not use salt on the roads.

In addition to the temporary diversion of Little Cherry Creek at the tailings impoundment, a permanent diversion ditch would be installed adjacent to NFS road #278 to direct runoff from the tailings impoundment (Figure 8). Diversion ditches would be constructed to capture runoff down gradient from all disturbances. To minimize the impacts of sediment, sediment traps and other

appropriate Best Management Practices (BMPs) would be installed. Below the tailings impoundment, where possible, ditches would be directed toward the Seepage Collection Pond; otherwise, appropriate BMPs would be used to handle storm water that was not classified as mine drainage water. Collection ditches/berms would be installed around the soil storage piles to reduce soil erosion/loss and control sediment impacts. Interim and concurrent reclamation would be employed where possible to reduce sediment loading and enhance soil stability.

Storm water associated with disturbance activities at the LAD Areas 1 and 2 (*i.e.*, access roads) would be directed toward the main access road and managed as part of the storm water management system. A series of ditches and berms would be constructed to control runoff from the road surface. Other areas would use standard BMPs to reduce sediment loading and to control erosion. A run-on diversion would be installed up gradient of LAD Area 1 to minimize the amount of water that would enter the site. The access road would provide run-on control to LAD Area 2.

2.4.2.5 Fugitive Dust and Erosion Control

2.4.2.5.1 Dust Control

A plan for mitigation of air quality impacts associated with fugitive dust is provided in MMC's Application for Air Quality Preconstruction Permit (TRC Environmental Corp. 2006a). A final fugitive dust control plan would be developed and implemented. MMC would use BMPs during construction, operation, and closure to control wind and water erosion. All appropriate precautions would be taken to minimize fugitive dust from all construction and operation activities related to the project, including concentrate transfer and loading activities at the Libby Loadout. These measures would include watering or applying dust suppression agents on unpaved roads and work areas on an as-needed basis.

Dust emissions from ore crushing, conveying, and other handling activities would be controlled with water sprays, wet Venturi scrubbers, and enclosures. Such control devices would be included on the primary crusher located underground, the conveyor belt, and the ore stockpile located adjacent to the mill facilities.

MMC's expects that seasonally, dust control at the tailings impoundment would occur continuously, but the decision to operate sprinklers at the tailings impoundment would be made based on regular inspection of the tailings impoundment during the day and on-site weather criteria to be established as part of the fugitive dust control plan. The presence of visible emissions, observed through shift inspection of the tailings impoundment by environmental personnel trained in visual opacity monitoring and by shift operators staffing the tailings impoundment, would prompt sprinkler operation. In addition, specific thresholds for weather conditions such as wind speed, precipitation, and humidity would be developed as part of the fugitive dust control plan to indicate the potential for fugitive dust emissions to occur, prompting sprinkler operation. Weather conditions and sprinkler operations if required would be documented (TRC Environmental Corp. 2006a).

All transfer operations and storage areas at the Libby Loadout would be completely enclosed. Concentrate transported by haul truck to the loadout would be dumped in an enclosed storage bin, and then transferred to rail cars. Loaded rail cars waiting for consolidation into a unit train would be covered to prevent wind losses and water pollution. The potential accumulation of concentrate along the haul truck turn-around, at the concentrate storage area, and along the railroad tracks

would be limited, and would be managed by regular clean-up with sweepers (TRC Environmental Corp. 2006a). Ground water monitoring wells would be installed at the loadout (Figure 12). Regular visual inspections would be completed by site personnel on reclaimed areas to evaluate where fugitive dust emission control measures were in place and properly functioning.

2.4.2.5.2 Erosion Control

MMC would use standard BMPs for sediment control such as interim reclamation, diversions, berms, sediment fence, sediment traps and ponds, and straw bales. Revegetation practices would be used to control water erosion by providing a stabilizing cover. Interim stabilizing measures such as water sprinkling, mulch, and tackifiers would be used until vegetation becomes established. Sediment would be contained from processing and material handling operations in lined sediment control ponds. Soil would be salvaged in two lifts at the impoundment. Subsoil with increased rock fragment content would be placed on the 4H:1V tailings dam face.

Reclamation equipment would be worked along contours where possible to minimize creation of erosion channels. When work on slopes must be perpendicular to contours, crawler tracking or dragging would be used. Windrows of woody debris or logs would be placed parallel to slope contours and the bases of long fills.

Reclaimed sites would be inspected periodically throughout the reclamation effort to assess progress toward meeting reclamation objectives. Slopes would be visually inspected for rills, gullies, and slope failures and repaired as needed.

2.4.2.6 Waste Management

Sanitary waste management would be the same for the construction and production phases. During the initial development phase, temporary, fully contained systems would be brought to the site. The self-contained units would be located at the Ramsey Plant Site and the Libby Adit Site. Once construction was completed or they were no longer required, the units would be removed from the sites.

During operations, MMC would install a closed sanitary system that would function similar to the self-contained units and would collect all gray and black water associated with the office, mill, and administration areas. MMC would install buried sewage tanks adjacent to the mill/office building complex and portable toilets would be located underground. Low-flow toilets and shower heads would be installed to minimize the amount of waste water generated. All sanitary waste would be pumped and disposed off-site. MMC anticipates one or two truck trips per week would be necessary to remove sanitary wastes.

Solid waste (excluding domestic/sanitary) would be transported off site to the Lincoln County landfill. No hazardous wastes would be generated by the operation. MMC would dispose of certain materials (ventilation bag, plastic pipe, lumber, and other similar materials) that were used for underground operations and that were damaged or exceed their useful life, would be placed in mined out sections of the mine. Records would be kept on disposal of materials underground and would include the general types of material disposed and the location of the disposal area in the mined out areas.

2.4.2.7 Transportation and Access

Traffic to the mine would use U.S. 2 and the Bear Creek Road (NFS road #278) and would include employee commuting and weekday delivery of supplies (Figure 2). Access road maintenance, including weed control, would be MMC's responsibility, unless additional use by the KNF or other interests would warrant a cost-share agreement. This responsibility would revert to the KNF or road owner following project completion.

The following sections describe road use and public access along the main access road (Bear Creek Road (NFS road #278) and in each proposed permit area. With the exception of the Bear Creek Road, all open roads in the proposed operating permit areas would be gated and limited to mine traffic only. Some gated or barriered roads would be used throughout operations for mine traffic only. Table 9 lists only those roads whose status would change in Alternative 2. For example, NFS road #2317 is listed in Table 9 because a 0.96-mile segment is currently open and would be gated in Alternative 2. NFS road #5184 is not listed in Table 9 because it is currently closed and would remain closed throughout the life of the project.

2.4.2.7.1 Bear Creek Road (NFS Road #278)

The current Bear Creek Road has a chip-and-seal paved surface. In order for MMC and the public to use the road safely together, some upgrading and widening of the road would be required. MMC is proposing to do these improvements and maintain the road as part of the project activities. About 10 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Bear Creek bridge, would be reconstructed to applicable road standards set by the either the KNF or Lincoln County. The road would be widened on its existing alignment and chip-and-seal paved. The roadway width would be 20 to 29 feet wide and designed to handle speeds of 35 to 45 mph. The disturbed area, included ditches and cut-and-fill slopes, is expected to be up to 100 feet wide. Road widening would be generally on the fill side of the road. Between U.S. 2 and the start of the proposed permit area boundary at Bear Creek, 79 acres would be disturbed. MMC would inspect the Bear Creek bridge for load capacity, but expects it would be sufficient for mine use. While NFS road #278 was upgraded in the first 2 years, the Libby Creek Road (NFS road #231) would be used for access.

Within the tailings impoundment area, the Bear Creek Road would be relocated and reconstructed in four locations (Figure 8). These sections, and non-realigned sections, would be chip-and-seal paved and the roadway widened to 20 to 29 feet, consistent with the road north of Bear Creek. About 0.5 mile south of the tailings impoundment area and west of the Bear Creek Road, MMC would build 1.7 miles of new single lane road that would connect the Bear Creek Road with the Ramsey Creek Road (NFS road #4781) (Figure 17). A new, single lane bridge over Poorman Creek would be built (Figure 13). Public access on Bear Creek Road would not be restricted. Public access to the new mine access road would be restricted to mine-related traffic.

Table 9. Proposed Change in Road Status, Alternative 2.

NFS Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
2317	Poorman Creek	LAD Area 1	Open	1.0	Gated, mine traffic only
2317B	Poorman Creek B	LAD Area 1	No closure order, impassable	0.8	Gated, mine traffic only
4781	Ramsey Creek	Between LAD Areas 1 and 2	Open	0.7	Gated, mine traffic only
278X	Bear Creek X	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.0	Gated, mine traffic only
5170	Poorman Creek Unit	LAD Area 2	Open	0.2	Gated, mine traffic only
5186	Ramsey Creek Bottom	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Gated, mine traffic only
278L	Bear Creek L	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.3	Gated, mine traffic only
1408	Libby Creek Bottom	Tailings Impoundment	No closure order, impassable	0.5	Gated, mine traffic only
5181A	Little Cherry Loop H Cowpath A	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.2	Barriered, no mine traffic
5182	Little Cherry Bear Creek	Tailings Impoundment	Open	1.6	Gated, mine traffic only
5183	Little Cherry View	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.5	Gated, mine traffic only
6201	Cherry Ridge	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.3	Gated, mine traffic only
6212	Little Cherry Loop	Tailings Impoundment	Open	1.4	Gated, mine traffic only
6212H	Little Cherry Loop H	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Barriered, no mine traffic
8838	Little Cherry MS 10377 8838	Tailings Impoundment	Open	0.2	Gated, mine traffic only

2.4.2.7.2 Little Cherry Creek Tailings Impoundment Area

The roads used to haul waste rock from the Libby Adit and the Ramsey Adits to the Little Cherry Creek Tailings Impoundment Area are shown on Figure 17. Except of a short segment of Bear Creek Road (NFS road #278) in the Little Cherry Creek Tailings Impoundment Area, mine haul roads would be restricted to mine traffic only. MMC would use a segment of the existing Bear Creek Road north of LAD Area 2 for mine haul. The crossing of the old Bear Creek Road across Poorman Creek would be built to accommodate the 100-year flow event and be constructed in compliance with INFS standards. It would either be a bridge or arched culvert. The crossing width would be consistent with the roadway width.

Besides the Bear Creek Road, Little Cherry Loop Road (NFS road #6212), NFS road #8838 and about a 1.6-mile long segment of NFS road #5182 are the only other roads within the tailings impoundment currently open to motorized access (Figure 17). Gates on the Little Cherry Loop Road (NFS road #6212) would be near the intersection with the Bear Creek Road on the north end and the tailings impoundment permit area boundary on the south end. NFS road #6212 would remain open to motorized access south of the proposed permit area boundary to the junction with Bear Creek Road. Gating the Little Cherry Loop Road (NFS road #6212) would restrict motorized access to NFS roads #5182 and #8838. At the end of operations, gates would be removed and motorized access reopened. A segment of the Little Cherry Loop Road (NFS road #6212) would be covered by the tailings impoundment and would not provide a loop between the Bear Creek Road.

Other NFS gated or barriered roads within the tailings impoundment that would be used during the construction, operation, and closure of the tailings impoundment include: #278L, #1408, #5181, #5183, #5184, #5184A, #5185, #5185A, #6201, #6212H, #8838, and #8841 (Figure 17). MMC does not anticipate using the following currently restricted or barriered roads within the proposed tailings impoundment operating permit area and they would remain closed: #1408 (disturbance boundary to #5181), #5003, #5181A, #6212H (disturbance boundary to #5181), #6201A, and #8838. MMC would have to consult with the KNF prior to removing the gates or barriers on these roads and using them.

About 7.5 miles of realigned and new road would be needed from the Bear Creek bridge to the Ramsey Plant Site. Motorized access to upper Ramsey Creek and the Poorman Creek Road (NFS road #2317) via NFS road #4781 would be restricted by a gate at the intersection of the Bear Creek Road and the Poorman Creek Road (NFS road #2317). A new bridge across Ramsey Creek would be built between the Ramsey Plant Site and the Ramsey Adit portals (Figure 3). The bridge would be sized to allow for a 50-year flow event. A temporary crossing from the Ramsey Plant Site to the Ramsey portal patio would be used and then removed following bridge construction. MMC would remove the bridge after it was no longer required to support mine operations and/or reclamation activities for the project.

2.4.2.8 Communications

Communications for the project would be provided by both a telephone system and a two-radio system. Telephone and data communications would be via new, buried utilities along the Bear Creek Road from Libby. MMC currently has radio communications to the Libby Adit Site and would use this system for secondary emergency communications. MMC is currently authorized to use the local county emergency radio system to communicate with emergency responders. In addition, a fiber optic line would be included on the transmission line and would provide

communications between the substations. No additional disturbance would be required for any of the communication systems for the project.

2.4.2.9 Project Employment

Construction would commence during Year 1, with the hiring of 135 employees, and would last about 4 years (Table 10). Construction employment would peak at 155 employees during Year 2. During Years 3 and 4, construction employment would be 65 employees. Total operations employment during Year 1 would be 30 employees, and is expected to reach 450 employees from Years 6 through 16 of the project. The mine is expected to operate 24 hours per day, 7 days per week, for 350 days per year. Maintenance repair and security activities would be scheduled during the remaining 2 weeks of the year.

Much of the construction work would be equipment and specialty services required for the project development. Each vendor or supplier may have a local distributor or hire local construction employees to assist in the installation or construction of their particular piece of the project. MMC expects up to 80 percent of the construction workers would be hired locally. MMC is committed to local hire and would encourage contractors to use local hire where possible, including partnerships with local businesses. MMC would work with local job services and educational institutions to outline the types of jobs and skills necessary for training purposes.

Table 10. Projected Project Employment.

	Construction			Production			
Year	1	2	3	1	2-5	6-10	11-16[†]
Production Rate (tons per day)	0	0	0	12,500	12,500	17,000	20,000
Construction[‡]	135	155	65	65	0	0	0
Operations	30	130	246	246	246	450	450
Total	165	285	311	311	246	450	450

[†]Production would continue for 3 to 4 more years if 120 million tons were mined; much lower employment during the 10- to 20-year closure period.
[‡]Construction employment includes a 23-person crew for the transmission line construction.

2.4.3 Reclamation Phase

MMC's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Specific objectives are: 1) long-term site stability, 2) protection of surface and ground water, 3) establishment of a self-sustaining native plant community where applicable and possible, 4) wildlife habitat enhancement, 5) protection of the public health and safety, and 6) attaining post-mining land use. The reclamation plan would be periodically revised to incorporate new reclamation techniques and update bond calculations. Prior to temporary or final closure, MMC would submit a revised reclamation plan to the lead agencies for approval.

2.4.3.1 Post-Mining Topography of Project Facilities

MMC would accomplish reclamation objectives by stabilizing disturbed areas during and following operations. MMC has developed specific plans for each disturbed area.

2.4.3.1.1 Rock Lake Ventilation Adit

The Rock Lake Ventilation Adit would be plugged with concrete and any surface disturbance regraded. The adit location is very steep and is likely bare rock; salvaging and replacing soil may not be feasible. If the site had salvageable soil and it could be safely removed, it would be salvaged and seeded. At closure, soil would be replaced and the area reseeded.

2.4.3.1.2 Ramsey Adits and Portals

Adit portals would be permanently closed upon completion of operations. Closure techniques would depend on whether water was produced at the opening. Dry openings would be sealed by using a concrete plug and backfilling with waste rock recovered from the portal patio. MMC would use water inflow data obtained during mining to predict the amount and quality of water expected from the adits. For entries producing water, a water-retaining plug would be installed in competent bedrock. Design of the water-retaining plug would be determined by hydrologic and geotechnical data. Water-retaining plugs may be located deeper into the adit than a dry plug; thus, mine entries from the portal to the plug would be backfilled. Final plugging design for "wet" openings would be prepared for lead agencies' approved before cessation of operations.

2.4.3.1.3 Ramsey Plant Site

The mill building, conveyors, bridges, administration offices, substations, and other facilities associated with this area would be dismantled and removed once they were no longer required to support mine operations or closure activities. MMC expects the majority of the Ramsey Plant Site facilities be removed, sold, scrapped, and/or disposed locally. Concrete foundations would be broken up and buried on-site. Inert materials would be placed underground for disposal and would be identified in the final closure plan. Buried utilities and pipelines would be left in place and the segment of the system that was exposed at the surface would be cut off 2 feet below the regraded surface and plugged.

The portal opening would be covered with material from the patio and graded to meet adjacent topography (Figure 18). The remaining portal patio area would be regraded to blend with the adjacent topography and promote runoff away from the disturbed area. The slopes would be graded to 2H:1V slope. The sediment control structure located below the portal patio would be regraded so it would not retain runoff once vegetative cover was established on this area. The access road from the Ramsey Creek bridge would be ripped and graded to match the surrounding topography. The bridge would be removed and the area regraded to minimize sediment loading to Ramsey Creek.

The Ramsey Plant Site would be constructed using a cut and fill sequence supplemented by a quantity of waste rock from the mine operations. Once all the buildings were removed, a portion of the fill material used to construct the mill site would be "pulled" back up the slope away from Ramsey Creek and placed into the cut side of the area. If the cut slopes were not stabilized by interim reclamation at plant closure, the slopes would be reduced to a 2H:1V slope. It is estimated that 87,250 cy of material would be graded during reclamation of the plant site. Internal roads and parking areas would be graded to blend in with the proposed final slope and revegetated using seeding and mulch. The Ramsey Access Road (NFS road #4781) would be reclaimed to pre-operation conditions.

2.4.3.1.4 Libby Adit Site

The DEQ currently holds a reclamation bond to cover reclamation of 11.6 acres at the Libby Adit Site, including plugging the adit, associated with its approval of Minor Revision 06-002. The KNF has not approved the activities described in Minor Revision 06-002 that may affect National Forest System lands. Activities associated with the Montanore Project that are outside the scope of Minor Revisions 06-001 and 06-002 would be a pipeline to LAD Area 1 and 2 from the Libby Adit Site, temporary utilities, and the road connecting the adit site with the tailings impoundment. Reclamation of the Libby Adit Site would follow procedures described for the Ramsey Plant Site. All structures would be removed, and above- and below-grade features would be resloped (Figure 19). The water well would be plugged in accordance with state regulations and all surface piping would be removed to below the ground surface. Internal roads and parking areas would be graded to blend in with the original slope and revegetated using seeding and mulch. Because the Libby Adit Site is on private land, MMC would maintain control of the property with a fence after mining was complete. The agencies would require a bond for long-term monitoring and maintenance, and possible long-term, post-closure water treatment in order to ensure ground and surface waters would be protected from unanticipated impacts.

2.4.3.1.5 Waste Rock Stockpile and LAD Areas

MMC expects all waste rock to be used in various construction activities. It is anticipated that no waste rock would remain at the LAD Area 1 stockpile after cessation of mining operations. Soil removed from this area prior to its use would be replaced, and the area revegetated.

The surge pond and sprinkler systems at LAD Areas 1 and 2 would be removed when discharge at the LAD Areas was no longer needed. MMC expects to use the LAD Areas after mining cessation to discharge tailings water (see discussion of Tailings Impoundment reclamation below). Any piping used to convey water from the operations to the LAD Areas would be removed and disposed offsite. Concrete outflow boxes would be broken up and buried on site. Surface disturbance from the access road, diversion ditch, and surge pond would be reclaimed and revegetated.

2.4.3.1.6 Tailings Impoundment and Borrow Areas

Tailings Impoundment and Dams

The basic reclamation plan for the tailings impoundment would consist of the following operations:

- Where possible, concurrently distribute soil and revegetate tailings impoundment dam lifts as completed during mine life. Trees would be planted on the reclaimed dam faces. Depositing sand-fraction tailings into the tailings impoundment during the final year of operation to produce the desired tailings gradient at closure (Figure 20).
- Drying the tailings impoundment surface by promoting natural drying/consolidation of tails, and evaporation. Revegetated areas on the tailings surface. If water quality meets applicable standards, tailings waters (supernatant of free standing water and water in the tailings mass at closure squeezed out of the tailings mass as the reclamation cap is placed) would be disposed through LAD Areas 1 and 2 or constructed wetlands peripheral to the tailings impoundment (see section 2.4.6.1, *Wetland Mitigation Plan*). If required, the Libby Adit Water Treatment Plant may be needed to meet MPDES permit limits.

- Grading the tailings surface as it dries enough to support equipment to eliminate any surface water ponding. The North Saddle Dam would be removed and the surface runoff from the reclaimed tailings impoundment surface would flow overland via a diversion ditch toward the northwest and ultimately into Bear Creek (Figure 20).
- Adding excess waste rock or borrow to help consolidate tailings, produce final reclamation gradients, and give structural support for placing the reclamation cover system.
- Replacing stockpiled soil salvaged from the site during construction in two lifts and revegetating all disturbances through seeding and planting.

All mechanical facilities associated with the tailings impoundment, including the above-ground pipelines, would be removed. All areas associated with the tailings impoundment would have soil replaced and revegetated following operations. The diversion structures for Little Cherry Creek above the reclaimed tailings impoundment would be reclaimed during operations and would remain, routing runoff into the permanent Diversion Channel to Libby Creek (Figure 20).

To minimize potential gully formation at the tailings dam crest, 83,000 cubic yards of riprap would be placed on the dam crest and uppermost part of the dam face. The coarse tailings portion of the dam face would be ripped and covered with 15 inches of rocky subsoil followed by 9 inches of topsoil. Nine inches of non-rocky subsoil followed by 9 inches of topsoil would be placed over the regraded surface of the tailings impoundment and the South Saddle Dam face. The riprap and rocky subsoil would either be excavated from within the impoundment footprint during impoundment and dam construction or excavated from borrow areas.

At closure, the tailings would continue to settle as the tailings consolidate, forcing some of the entrained water in the tailings mass to the surface. Dewatering activities would be implemented to remove this water while incrementally placing the reclamation cover as dewatering activities progressed. An estimated average of 4 feet of fill would be needed to create the proposed final grade needed before soil was placed on the tailings impoundment surface. The fill would either be excavated from within the impoundment footprint during impoundment and dam construction or excavated from borrow areas. It would take up to 20 years for settling and consolidation to stop and to complete the entire cover on the tailings impoundment surface. During operations, MMC would use conventional methods to estimate the amount of tailings settling. MMC would use the estimate to design the final reclaimed pond surface configuration and to determine the amount of earthwork that would be required. MMC anticipates that a shallow depression may form in the center of the tailings impoundment due to tailings settlement. Sand-fraction tailings would be used in the last year of operations to help create the final gradient needed. During grading activities, the depression would be filled with sand tailings, mine waste rock, and/or material from the North Saddle Dam. The amount of tailings consolidation would dictate the final soil and fill volume needed to meet plan designs and would be updated periodically during the life of the project.

During the last year of operation, when the tailings dam crest had been completed to its ultimate operating level, the remaining portion of the cycloned coarse tailings (370,000 cy) would be deposited into the impoundment along the eastern and southern sides of the impoundment and would form a berm. The berm would be graded to the northwest at a 0.5 to 1 percent slope (Figure 20). The final tailings topography would be contoured to direct surface water runoff toward Bear Creek. The North Saddle Dam would be removed so that runoff would drain from

the reclaimed tailings impoundment surface toward the Bear Creek drainage. MMC would design a riprapped channel to Bear Creek. The design would incorporate features that provide for stability of this transition zone so that sediment loading was not increased. Post-operation topography would be achieved primarily by spigoting arrangements in the final years of operation. A small, rockfill check dam would be located just beyond the northwest end of the reclaimed impoundment. The check dam would be designed for the 100-year storm event. Sediment would be removed from behind the dam, if necessary. The final runoff diversion ditch on the upper end of the tailings impoundment to divert water toward the northwest would be left (Figure 20). This ditch would be riprapped with rock to prevent erosion and would be designed for long-term stability. The ditch would be sized to convey the 100-year storm event.

Borrow Areas

The borrow areas would remain until the impoundment reclamation plan was completely implemented to ensure no fill material was required. The borrow area slopes would be reduced to at least a 2H:1V slope and graded to ensure storm water does not leave the borrow area. The bottom of the borrow pit would be ripped to reduce water retention. Once the areas were no longer needed, the areas would be covered with soil and reseeded.

Post-Closure Water Management

At the end of operations, excess water would be present in the tailings impoundment. The volume of accumulated water would vary monthly in response to precipitation and evaporation and discharges to the LAD Areas 1 and 2. To enhance the removal of water and tailings consolidation, the use of evaporation by spraying on the tailings impoundment surface or LAD Areas 1 and 2, or other approved methods would be employed.

Following cessation of mining, the tailings impoundment would be partitioned to provide an area for water storage. The water level within the tailings would be lowered so construction equipment can work on the surface. Dewatering the top few feet of tailings would be accomplished by promoting natural drying and evaporation. MMC anticipates some difficulty in dewatering the tailings in the center portion of the tailings impoundment surface containing the fine tailings. The tailings in this area would have low bearing capacity. Subgrade reinforcement, such as a geotextile, may be needed for construction equipment to work on the tailings surface. MMC estimates that 10 percent of the area would require this technique and would likely be focused in the area where the final impoundment pond existed.

Seepage through the tailings dams would continue following reclamation. The seepage collection system would remain in place. Seepage to the underdrain system is expected to decrease from 930 gpm to 200 gpm 10 years after closure, stabilizing at a rate of 50 to 100 gpm over a longer period (Klohn Crippen 2005). Seepage collected in the pond would be pumped to the tailings impoundment where it would evaporate, be distributed to LAD Areas 1 and 2, or be used to irrigate reclaimed areas. Seepage from the tailings not collected by the underdrain system is estimated to decrease from 25 gpm during operations, and 22 gpm at closure, to 17 gpm in the first 10 years after closure, and stabilizing at 5 gpm over the long term (Klohn Crippen 2005). The seepage would mix with the underlying ground water and be intercepted by the pumpback well system. MMC would operate the seepage collection and the pumpback well systems until water quality standards or BHES Order limits were met without additional treatment. Long-term treatment may be required if water quality standards were not met. The length of time these closure activities would occur is not known, but may be decades or more.

Following removal, the Seepage Collection Dam and Pond would be graded to blend in with the original slope (Figure 20). After water quality standards or BHES Order limits were met and the Seepage Collection Dam and Pond was removed, seepage from the underdrain system would flow down the former Little Cherry Creek drainage to Libby Creek. Seepage not intercepted by the underdrain system would mix with underlying ground water and flow to the former Little Cherry Creek or Libby Creek.

2.4.3.1.7 Roads

Roads retained after mine operations and reclamation plans are discussed in MMC's Road Use Technical Memo (MMC 2007). MMC's general road reclamation approach would be as follows:

- Bear Creek Road – The Bear Creek access road (NFS road #278), from U.S. 2 to south of the tailings impoundment, would not be returned to its pre-mine width and the roadway would remain 20 to 29 feet wide. Cut-and-fill slopes associated with widening the Bear Creek access road from U.S. 2 to the new Ramsey Plant access road would be reclaimed immediately following construction.
- New Roads – All new roads, except the Bear Creek access road, constructed for the project would be reclaimed, which includes grading to match the adjacent topography, obliterating the road prism. This would include all roads constructed for the project.
- Open Roads – Reclamation of open roads upgraded for operations previously open to the public use would be completed to allow the road to be retained and used in a manner consistent with the pre-operational conditions. The surface would be bladed and sediment control systems inspected and replaced, as necessary. The bridge on NFS road #6210 would be removed and would be reclaimed consistent with open roads.
- Closed or Restricted Roads – Closed roads used for mine operations would be reclaimed to pre-mine conditions. Access restrictions would be upgraded or installed (gates, kelly humps, etc.) as required by the KNF, and the road surface would be scarified and seeded.

Available soil would be salvaged from disturbed areas and redistributed on fill and cut slopes where possible. Where soils were not salvaged during road construction, the road surface would be scarified and prepared for seeding. Soil would not be respread on cut slopes in consolidated material. Resoiled slopes would be broadcast seeded or hydroseeded with the planned seed mixture, dozer tracked where possible, and fertilized and mulched as necessary. Seeding of trees and bare-root shrubs is not planned for the roads that were not completely obliterated. MMC would inspect sediment control features and repair or replace controls as needed.

2.4.3.2 Interim and Concurrent Reclamation

To maximize site stabilization, weed control, and early completion of final reclamation, MMC would identify appropriate areas each year for interim and concurrent reclamation. Interim reclamation would be conducted in areas where disturbance was required during construction and/or operations. Potential interim reclamation areas include soil stockpiles, road cut/fill sections, borrow pits, plant site fill slopes, and other similar areas. Concurrent reclamation would be completed in areas where mine activities were completed and where no additional disturbance was anticipated. Potential concurrent reclamation areas include the tailings impoundment dam

face, borrow pits, temporary roads, and other similar features. Interim and concurrent reclamation would be carried out using the same techniques, seed mixtures, and fertilizer types/application rates as described in the final reclamation activities for the project. Where possible, interim and concurrent reclamation would occur within the same year of disturbance. The necessity for additional reclamation in areas where interim reclamation had occurred would be evaluated by the lead agencies at closure.

2.4.3.3 Revegetation

Compaction and handling would be minimized as much as possible. Soil replacement depths would average 24 inches on the tailings impoundment dam and 18 inches on all other disturbed areas. Soils would be removed in two lifts on a portion of the tailings impoundment area. The areas selected for double lift salvage would have more rock fragments in the subsoil.

Before soil redistribution, compacted areas, especially the adit portal areas, roads, soil stockpile sites, and facilities area, would be ripped to reduce compaction. Ripping would eliminate potential slippage at layer contacts and promote root growth. Soil salvage and redistribution would occur throughout the life of the operation.

Selection of plant species for revegetation was based on pre-mine occurrence; post-operation land use objectives; establishment potential; growth characteristics; soil adaptation and stabilizing qualities; wildlife palatability; commercial availability; and expected moisture, temperature, and soil conditions. Two plant mixtures are proposed: one dominated by species typically found in moist, relatively cool sites, and one with species suited to a wider range of growing conditions. Seed mixtures may be modified, with the lead agencies' approval, due to limited species availability, poor seed quality, site differences, poor initial performance, or advances in reclamation technology. Forbs would not be used in seed mixtures used on roadsides to avoid attracting bears. Seed mixtures would be dominated by native species. Prior to reclamation, MMC would submit seed information such as seed content and germination testing results to the lead agencies. The lead agencies would adjust seed mixtures as appropriate for site conditions and to meet any KFP changes.

Seeding rates were designed to average 90 to 100 live seeds per square foot for drill seeding and roughly twice that for the broadcast seeding. Drill seeding would occur on slopes of 33 percent or less. Rocky slopes, areas where organic debris had been spread, or slopes greater than 33 percent would be broadcast or hydroseeded.

On slopes of 33 percent or less, the seedbed would be disced and harrowed. After seeding, straw mulch would be applied at 0.5 to 1.5 tons per acre and anchored with a straw crimper. Some hydroseeded areas of slopes steeper than 33 percent would be mulched with a cellulose fiber mulch and a tackifier. Fertilizer application rates would be based on soil tests; phosphorus fertilizer would be applied before seeding; and nitrogen fertilizer would be applied in growing seasons after seeding.

Tree and shrub seedlings would be planted in selected areas of the Ramsey Plant Site, the Libby Adit Site, and the tailings impoundment. Shrubs and trees would not be planted on soil stockpile sites, portal patios, or along road corridors. Planting density would be 435 trees per acre and 200 stems per acre for shrubs. Seedlings would be planted either continuously in strips on steeper slopes or in highly visible areas, or in randomly placed groupings on level to gently sloping areas. Containerized seedlings would be used when available. When bare-root stock was used, planting

densities would be increased by 10 to 15 percent, depending on planting success of containerized stock versus bare-root stock.

Interim revegetation would take place on certain disturbed areas, such as roads, stockpiles, transmission lines, pipelines, and other areas, to reduce erosion and sedimentation. These areas would be broadcast seeded with the interim seed mixture, mulched, and fertilized as necessary. As the tailings dam increased in height, only final slopes would be reclaimed using the permanent seed mixture. All other unreclaimed disturbances would be reclaimed within 2 years after mining completion.

If feasible, seed or plant materials would be collected on site, and soils used for planting trees and shrubs would be inoculated with mycorrhizae. Seeds of species preferred by grizzly bears may be collected and used to supplement existing seed mixtures. When available, blister-rust resistant species would be used.

2.4.4 Temporary Cessation of Operations

Although a temporary cessation of operations is not planned, uncontrollable circumstances may cause a short-term stoppage in operations. Temporary cessation of operations refers to the suspension of ore processing and/or mining for an anticipated period of up to 1 year. Major steps to be undertaken would include the following:

- Continuing mine dewatering
- Maintaining water management (including treatment, etc.)
- Maintaining all monitoring activities
- Clearing and repairing site drainage and sedimentation control structures to ensure proper runoff and sedimentation control over a sustained period of time
- Contouring and seeding areas susceptible to erosion
- Securing monitoring wells, pumps, and intake structures to prevent equipment damage
- Maintaining access roads to insure project access
- Inspecting, repairing, or replacing signs and fencing around the property
- Implementing a facility inspection program
- Controlling noxious weeds
- Continuing dust suppression activities on the tailings beach and dam face

MMC would maintain the operation so that startup could be initiated quickly when the situation causing the temporary closure was eliminated. Staffing levels may be reduced to levels necessary but would provide staffing and coverage properly to maintain the facilities and permit. MMC would notify the lead agencies 30 days prior to any project startup. If the temporary closure were required for an extended period of time (greater than 1 year), MMC would meet with the lead agencies to discuss the project and issues that should be addressed in a temporary closure plan. MMC would submit the temporary closure plan that would outline the specific activities necessary to provide interim protection of resources.

2.4.5 Operational and Post-Operational Monitoring Programs

MMC would conduct operational and post-operational monitoring and provide monitoring results to the lead agencies in the annual report for hydrology, aquatic life, tailings dam stability, and revegetation.

2.4.5.1 Hydrology

Surface and ground water would be monitored during operations at various locations throughout the project area. Ground water monitoring would consist of periodic ground water level measurements and collection of samples for laboratory analysis. Proposed monitoring well locations would be located above and below all major project facilities. MMC would install the ground water monitoring wells prior to mine construction to establish pre-construction conditions. If the lead agencies determined additional monitoring wells were required for land application in the tailings area, these would be installed prior to construction activities.

Surface water monitoring would be conducted during the life of the project in conjunction with monitoring of aquatic life. Surface water monitoring would consist of periodic streamflow measurements and collection of samples for laboratory analysis. Any adit discharge would be monitored for quality and flow. Water levels in the tailings impoundment would be measured periodically. Sediment sampling at LB 2000/L2 downstream of the confluence of Little Cherry Creek with Libby Creek would be conducted daily during construction activities, every other day during initial mine operation, and once per week during mine operations/reclamation.

MMC would implement monitoring at Rock Lake to estimate existing ground water discharge to the lake that would allow subsequent detection of small changes in discharge due to possible dewatering effects of the project. Water budget variables would be measured or estimated, including evaporation, precipitation, surface water inflows and outflows, ground water inflows and outflows, and continuous lake levels. The lake monitoring system design and evaluation would be coordinated with the lead agencies. If substantial increased mine inflows occurred near Rock Lake, MMC would submit continuous lake level data, weather permitting, and any other lake level data accumulated during the year, within 5 working days and would provide data and evaluation at an increased frequency as determined by the lead agencies.

MMC would collect monthly samples to establish pre-construction conditions in the Little Cherry Creek ground water wells from March, or as soon as weather permits, through November of the same year. Monitoring wells at LAD Areas 1 and 2 would be sampled monthly whenever mine water was discharged to the LAD Areas 1 and 2, and would continue for at least 1 year following the cessation of discharges. If nitrate or ammonia concentrations increased in ground water, MMC would notify the lead agencies within 2 weeks and initiate twice-a-month monitoring of all adjacent surface and ground water stations.

At the end of the first monitoring year and following submittal of the annual report, MMC would meet with the lead agencies to discuss the monitoring results and evaluate the effectiveness of the LAD system. Following the annual review, the lead agencies would decide whether a change in monitoring or operations would be required. MMC would present the details of the additional monitoring in the final water management/treatment plan to be submitted to the lead agencies for approval that may be deemed necessary based on the annual reviews.

MMC would prepare a report briefly summarizing hydrologic information, sample analysis, and quality assurance/quality control procedures following each sample interval. Data would be submitted to the lead agencies by MMC within a reasonable time (5 to 7 weeks) after each sampling trip. MMC would submit an annual report to the lead agencies summarizing data over the year. In the annual report, MMC would present a detailed evaluation of the data. Data would be analyzed using routine statistical analysis, such as analysis of variance.

2.4.5.2 Aquatic Life and Fisheries

MMC would monitor aquatic insect and periphyton populations at nine sampling locations in the project area. Sampling locations would include one each in Ramsey, Poorman, Little Cherry, and Bear creeks, and five in Libby Creek. MMC would monitor during three periods: in April prior to runoff, in August during late summer flows, and in October prior to ice forming in the streams. MMC would monitor fish populations in Libby Creek at 2-year intervals in four stream reaches in lower Libby Creek. Population densities of each fish species captured during the monitoring would be estimated. The condition of all captured fish would be recorded. MMC would estimate the seasonal variation in fine sediment loading (embeddedness) at each sampling station using the "substrate score" methodology. If bull trout spawning or bull trout redds were observed at the four fish monitor stations (L1, L3, L9, and Be2), the surface embeddedness monitoring would be supplemented with the "McNeil Core" substrate sampling methodology, using five representative core samples.

MMC would measure background concentrations and document potential changes in the concentrations of cadmium, mercury, and lead in the fish of Libby Creek. Each year, for 5 years, MMC would collect 10 cuttbow trout, each greater than 4 inches in size, and 10 adult sculpins from Libby Creek at three stations. Collections would be completed during the late-summer to early fall low-flow period. Tissue samples, including homogenized flesh and skin from each fish, would be analyzed to determine cadmium, mercury, and lead concentrations. Thereafter, MMC would resample each site at a 3-year interval to document the trends in bioaccumulation of these metals. MMC would tabulate sampling data and present the monitoring results in the annual reports.

2.4.5.3 Tailings Impoundment

The monitoring program consists of four primary areas to be monitored: milling and material production; water balance; geotechnical stability and dam construction; and environment and closure (Table 11).

Reconciliation of the mass balance would be carried out on an annual basis, in conjunction with the water balance. Milling, production, and cyclone records would be kept to document "as-built" conditions. Records of dam construction, including borrow, mine waste rock, and cyclone sand volumes would be maintained. During operations, annual surveys of the impoundment, including water stored of the pond, would be carried out to assist in the reconciliation of mass balance.

The water balance would be reconciled on an annual basis, in conjunction with the mass balance. Records of all flows would be reconciled and the water balance also would use the measured precipitation and evaporation rates on site and observations of areas of beaches and water ponds.

Table 11. Tailings Impoundment Monitoring Program, Alternative 2.

Technical Area	Item	Monitoring Parameters	Frequency	Comments
Milling and Materials	Thickener underflow feed line to tailings impoundment	Tons and Gallons	Daily	Compiled monthly and reconciled on an annual basis with the water balance Reconcile mass balance with density of tailings (dam and impoundment)
	Secondary cyclone feed line to dam.	Tons and Gallons	Daily	
	Secondary cyclone – underflow and overflow	Tons and Gallons	Daily	
	Water storage in impoundment	Volume of water	Annually	
Dam Volumes	Cycloned sand, borrow, and mine waste rock)	Tons and cubic years per year	Annually	Annual reconciliation of fill materials
Water Balance	Reclaim pumping rates (volume)	Gallons/day	Daily	Compiled monthly and reconciled on an annual basis
	Irrigation pump rates	Gallons/day	Daily	
	LAD application rates	Gallons/day	Daily	
	Underdrain collection flows	Gallons/day	Weekly	
	Precipitation	Inches	Daily	
	Evaporation	Inches	Daily	
	Approximate pond areas	Acres	Monthly	
	Approximate wet and dry beach and dam areas	Acres	Monthly	
Water Quality	Reclaim water	All parameters listed in Operating Permit #00150 or MPDES Permit MT-0030279	Monthly	
	Mine water		Monthly	
	Groundwater seeps		Quarterly	

Technical Area	Item	Monitoring Parameters	Frequency	Comments
Geotechnical Stability	Piezometers - Main dam (10) - South dam (2) - North dam (2) - Diversion dam (2)	Piezometric levels	Monthly	Monitoring of potential pore pressures in the clay; and "normal" dam monitoring
	Inclinometers - Main dam (3)	Deformation (inches)	Monthly	To be located in areas of potential clay
Dam	Material properties	Density and gradation	Weekly	A QA/QC program would be implemented to measure and monitor density and gradation
Environment	Dust	Visual	Monthly	Routine observations to document potential dust and wildlife use of area
	Wildlife	Visual	Monthly	
Closure[†]	Consolidation of tailings (10 - settlement plates)	Inches of settlement	Quarterly to annually	
	Piezometers in the impoundment (10)	Phreatic level	Quarterly to annually	
	Revegetation plots	Acres of replanting	Quarterly to annually	

[†]The operational monitoring would continue for the decommissioning stage until "steady state" conditions were met. Frequency would progressively decrease to quarterly and annually.

Ground water monitoring wells would be installed downstream of the Main Dam and downstream of the Seepage Collection Dam. The ground water monitoring wells would be installed along the two representative hydrogeological sections of Libby Creek and Little Cherry Creek. The location of ground water monitoring wells would be determined during final design. The wells would be installed at various depths to monitor the main hydrogeologic units including both shallow and deep soil/weathered rock units. Additional wells would be installed downstream of the North Saddle Dam and South Saddle Dam, later in the life of the mine. A preliminary schedule of monitoring wells is presented in Table 11; final well number and locations would be determined during final design. Flow measurement weirs also would be installed downstream of the Seepage Collection Dam and, during operations, in any areas of observed flows. Flow in the Little Cherry Creek Diversion Channel would be measured monthly, and dam seepage flows would be measured quarterly.

During operation, stability monitoring would include the following:

- Piezometers in the dam foundation and fill
- Inclinometers extending through the potential clay units in the foundation
- Seepage monitoring

Electric piezometers would be installed in the dam foundation to measure pore pressures during construction, with particular attention to areas where the glaciolacustrine clay is present in the foundation. Appropriate "trigger" levels would be established, in conjunction with the detailed stability analysis, to provide a management tool to respond to higher than predicted responses. Piezometers also would be installed in the cycloned sand section to monitor the "drawdown" of cyclone water within the dam fill. The piezometers cables would be buried and led to a common readout station at the toe of each dam. Continuous data reading equipment would be installed.

Inclinometers would be used to monitor potential deformation of the dam foundation. The inclinometers would be installed in areas of glaciolacustrine clay and would be extended up through the dam fill. Quarterly observations of any seepage would be documented. The seepage observations would include evidence of piping, flow estimate, and water quality.

Construction QA/QC of dam construction activities would be carried out by a qualified consultant. Responsibilities of the site engineer(s) during construction would be detailed in a field manual prior to construction and would include standard field and laboratory quality control tests.

Observations would be taken and documented during operations, such as dust from the tailings beaches, including length of time dust was generated, and aerial extent of dried area. The use of the area by wildlife, such as waterfowl, also would be noted.

The monitoring program would continue into the closure stage, although the frequency of records would be reduced accordingly as steady state conditions were reached. The following monitoring would be carried out during the reclamation phase:

- Piezometers would be installed within the tailings impoundment area to monitor the progressive "drawdown" of the phreatic surface
- Settlement plates would be installed over the tailings impoundment area to monitor the consolidation/settlement of the tailings to help confirm predicted consolidation behavior for closure
- Monitoring of the success of the ongoing progressive revegetation program would be continued until steady state conditions were reached

Stability monitoring of the dam would be performed during operation and after closure. The downstream slope and toe of the tailings dam, the North and South Saddle dams, the Diversions Dam, and the Seepage Collection Dam would be visually inspected daily for evidence of seepage exiting the slope or the downstream toe. A V-notch weir would be located at the downstream toe of the dam to monitor seepage rates. If seepage were noticed, both the seep location and estimated quantity of flow would be recorded and the project geotechnical engineer immediately contacted for inspection and recommendation for mitigation measures, if necessary. During operations, the dam and associated structures would be inspected weekly and measurements taken of freeboard adequacy; beach width; cracking, sloughing, depressions, and erosion of the dam and abutments; changing trends in seepage quantities, piping, and wet spots; and the condition of the Diversion Channel.

2.4.5.4 Air Quality

MMC has committed to implementing the monitoring requirements developed by the DEQ for the draft air quality permit. The monitoring plan is summarized in this section and discussed in

the DEQ's draft permit (DEQ 2006a). MMC would submit to the lead agencies for approval a general operating plan for the tailings impoundment site including a fugitive dust control plan to control wind erosion from the site. The plan would include, at a minimum, the embankment and cell (if any) configurations, a general sprinkler arrangement, and a narrative description of the operation, including tonnage rates, initial area, and timing of future enlargement.

MMC would install, operate, and maintain three air monitoring sites near the mine and facilities. The exact location of the monitoring sites would be approved by the DEQ. MMC would begin air monitoring at the commencement of mill facilities or the tailings impoundment and continue air monitoring for at least 1 year after normal production was achieved. MMC would analyze for metals shown in Table 12 on the PM_{10} filters once the mill facilities and tailings impoundment were operational. At that time, the DEQ would review the air monitoring data and determine if continued monitoring or additional monitoring was warranted. The DEQ may require continued air monitoring to track long-term impacts of emissions for the project or require additional ambient air monitoring or analyses if any changes took place regarding quality and/or quantity of emissions or the area of impact from the emissions.

Table 12. Required Air Quality Monitoring, All Alternatives.

Location	Site	Parameter	Frequency
Plant Area	Site #1	PM-10[1] As, Cu, Cd, Pb, Zn[2] PM-2.5[3]	Every 3rd day according to EPA monitoring schedule
Tailings Area (Up-drainage)	Site #2	PM-10[1] As, Cu, Cd, Pb, Zn[2] PM-2.5[3]	Every 3rd day according to EPA monitoring schedule
Tailings Area (Down-drainage)	Site #3	PM-10[1] / PM-10[1] Collocated As, Cu, Cd, Pb, Zn[2] PM-2.5[3] / PM-2.5[3] Collocated Windspeed, Wind Direction, Sigma theta[4]	Every 3rd day according to EPA monitoring schedule (Collocated every 6th day) Continuous

[1] PM-10 = particulate matter less than 10 microns.
[2] As = Arsenic, Cu = Copper, Cd = Cadmium, Pb = Lead, Zn = Zinc.
[3] PM-2.5 = particulate matter less than 2.5 microns.
[4] Sigma Theta = Standard Deviation of Horizontal Wind Direction.

2.4.5.5 Revegetation

MMC would complete soil tests to determine the appropriate fertilizer mix required for successful reclamation. The fertilizer mix and rate would be approved by the lead agencies before being used. Interim reclamation activities would provide opportunities to evaluate the most effective use of fertilizers for final reclamation. The vegetation cover, species composition, and tree planting success would be evaluated during the first year following reseeding or replanting. In addition to a general evaluation, MMC would conduct vegetation monitoring every 2 years during operations at sites representative of various types of disturbance. Control sites in areas unaffected by the project would be established to provide information on site conditions. Reports summarizing survey data would be submitted to the lead agencies. MMC would develop reclamation bond release criteria as part of the overall reclamation plan reviewed and approved

by the lead agencies. Part of the release criteria would involve specific, qualitative measurement of revegetation success.

At the end of mine operations, MMC would conduct similar vegetation monitoring every year at sites representative of various types of disturbance. The following characteristics would be evaluated:

- Plant species responses (germination, growth, competition)
- Total and vegetative cover
- Plant species and plant diversity (including weeds)
- Procedures to reclaim steep rocky slopes
- Soil redistribution depth
- Soil rock fragment content
- Effects of fertilizer rates
- Tree planting techniques
- Tree stocking rates
- Viability of bare-root versus containerized stock

MMC would request bond release in phases as specific tasks were completed. The following criteria for revegetation success and bond release would apply to areas where revegetation is the primary reclamation objective:

- Cover – Total cover was least 80 percent of the control site total cover, or the site met a total cover of 70 percent with at least 60 percent of that cover being a live plant community
- Diversity – Dominance by no more than three acceptable plant species, either in the seed mixture or the local native plant community
- Noxious Weeds – No more than 10 percent noxious weeds
- Rills and Gullies – No rills and gullies greater than 6 inches deep and/or wide

Success criteria must be met for 3 years to meet reclamation objectives. If success criteria were not met, MMC would modify seed types and reclamation techniques as appropriate and conduct a second seeding. If the site was stable but still did not meet vegetative release criteria, MMC may modify the plan and reseed again, and would request bond release by the lead agencies.

MMC would regrade and revegetate areas where rills and gullies exceeded the release criteria. If rills and gullies persisted, MMC would review run-on conditions and regrade and/or install sediment control features as appropriate. If site stability was still not achieved, MMC would consider armoring the rills and gullies with riprap, rock lining, or other similar materials to provide a stable drainage pathway. Once the site exhibited stability for 3 years, MMC would request bond release by the lead agencies.

Vegetative monitoring also would assess noxious weeds. Measures outlined in MMC's Weed Control Plan approved by the Lincoln County Weed Control District would be followed during operations and reclamation to minimize the spread of weeds to reclaimed areas. If weed content were above 10 percent, MMC would implement additional weed control methods and apply weed

control treatment for 2 years. If after 3 years, the percent of weeds at the reclaimed site were 50 percent of the control site's weed population, MMC would request bond release.

2.4.5.6 Cultural Resources

All remaining un-inventoried potentially affected areas would be intensively inventoried for prehistoric and historic resources. If previously undiscovered cultural resources were encountered, work in the immediate area would stop, and the KNF and the State Historic Preservation Office would be notified. MMC would meet with KNF personnel to determine potential resource value and implement recordation and/or excavation program as required. Site documentation would be provided to the KNF. No additional disturbance would proceed until the lead agencies gave approval.

2.4.6 Mitigation Plans

2.4.6.1 Wetland Mitigation Plan

MMC developed a conceptual mitigation plan designed to replace wetland functions and values lost as a result of the project. MMC would replace the existing forested and herbaceous wetlands affected by the project on a 2:1 basis. For example, 10 acres of forested or herbaceous wetlands would be created for every 5 acres of forested or herbaceous wetlands disturbed. Herbaceous/shrub wetlands and waters of the U.S. would be mitigated with wetlands at a 1:1 ratio. MMC identified 44.6 acres of possible wetland mitigation areas. MMC believes the identified mitigation would be more than the required mitigation acres and should provide flexibility in selecting mitigation by the lead agencies and the Corps. MMC would create or expand existing wetlands at the following locations (Figure 21):

On-Site

- Little Cherry Creek–2.2 acres
- Little Cherry Creek Diversion–1.6 acres
- Unspecified Little Cherry Creek Site–5 acres

Off-Site

- North Poorman–3.4 acres
- South Poorman–9.7 acres
- Poorman Weather Station–14 acres
- Libby Creek Recreational Gold Panning Area–2 acres
- Ramsey Creek–6.7 acres

2.4.6.1.1 On-Site Wetland Mitigation

On-site wetland mitigation would consist of 8.8 acres within the permit area boundaries. The Diversion Channel around the tailings impoundment would be designed to provide hydrologic functions and values similar to those provided by the conifer-dominated wetlands in riparian areas. MMC anticipates 1.6 acres of wetlands would be created in the Diversion Channel.

Two mitigation sites are proposed in the Little Cherry Creek drainage downstream of the tailings impoundment. One site, not specifically identified, would use ground water collected from beneath the tailings impoundment to create and maintain wetlands. Flows are expected in the range of 30 gpm and would be directed down low-gradient channels constructed to allow water to flow between and collect in a series of depressions. A complex of herbaceous/shrub wetlands of 5 acres would be created by directing these flows. The wetlands are anticipated to replace functions and values provided by existing herbaceous/shrub wetlands.

The other wetland mitigation site in Little Cherry Creek is along the northern side of the proposed tailings impoundment on land owned by MMC. This area contains a small existing wetland complex. MMC would increase the size of the existing wetlands through small excavations and dams that would retain water longer. MMC may use ground water collected from beneath the tailings impoundment, if needed. An estimated 2.2 acres of additional shrub-dominated wetlands might be developed at this site.

2.4.6.1.2 Off-Site Wetland Mitigation

About 35.8 acres of potential wetland mitigation sites have been identified near the project area but are outside the permit area boundaries: three sites in the Poorman Creek area, one site within the Libby Creek Recreational Gold Panning area, and one site along Ramsey Creek near the LAD Areas. The Poorman Creek sites include South Poorman, North Poorman, and Poorman Weather Station sites.

The proposed South Poorman site is adjacent to an existing 5.9-acre wetland. It could consist of 1.4 acres of new wetlands on the northern side of the existing wetland, and 8.3 acres immediately south of the existing wetland. The North Poorman site is adjacent to and north of a small existing wetland. About 3.4 acres of additional wetlands could be developed at this site. The Poorman Weather Station is not within an area of existing wetlands and has no well defined drainage. About 14 acres of new wetlands could be developed at this site.

All three Poorman sites have soils and terrain similar to that of the proposed Little Cherry Creek Impoundment Site. Wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. Artesian wells would be developed to supply water if natural runoff were insufficient to maintain hydrophytic vegetation.

Two acres of newly constructed wetlands could be developed at the Libby Creek Recreational Gold Panning Area. Portions of the existing coarse placer piles would be removed, recontoured to expose ground water, and revegetated. These new wetlands would be shrub and forb dominated initially, but would eventually become conifer dominated. The Ramsey Creek site is located near the proposed LAD Areas 1 and 2. It is part of an existing human-made wetland area, and would be expanded by spreading out streamflow that feeds the site. MMC estimates this site could be expanded by an additional 6.7 acres.

2.4.6.1.3 Monitoring

To determine the success of the wetland mitigation, a monitoring program would be initiated after construction of wetlands to assess vegetation growth, hydrological conditions, wildlife use, and integrity of constructed wetlands. Vegetation growth would be monitored in June and August following the first growing season. Monitoring would continue until the Corps had determined that wetland plant communities predominate and the mitigation wetland was self-sustaining, or for a period of 5 years, whichever was greater. Less intensive monitoring would then take place

every 2 years thereafter until the end of operations. Species composition and canopy coverage would be recorded for constructed wetland plant communities. Growth of seeded and non-seeded (volunteer) species would be recorded. If seeded species did not become established, supplemental seedings and transplanting would be undertaken. If noxious weeds invaded wetland areas, they would be removed by mechanical methods or other methods approved by the Corps.

The hydrological status of wetlands would be monitored during spring and fall. Surface water depth would be recorded. If no surface water were present, test holes would be excavated to determine the depth of free water and saturated soil. Wildlife use would be monitored in the spring and late summer. Integrity of constructed wetlands would be monitored.

MMC would monitor any effects to existing wetlands downstream of the tailings impoundment. Monitoring of the downstream wetland areas would be completed annually for the first 5 years of mine operation. If functions and values of downstream wetlands were adversely affected, MMC, in cooperation with the lead agencies and the Corps, would develop additional wetland mitigation.

2.4.6.2 Fisheries Mitigation

MMC proposed the fisheries mitigation developed collaboratively in 1993 by the KNF, FWP, Corps, and EPA to mitigate the fisheries impacts associated with the Little Cherry Creek diversion and the riprapped tailings impoundment overflow channel to Bear Creek. These impacts include the loss of recreational fishing opportunity and the loss of fisheries production in Little Cherry Creek. Before any other mitigation work was attempted, and immediately before closure of the Little Cherry Creek Diversion Dam, MMC would collect all fish in the existing stream section and move the fish to the newly constructed diversion channel. MMC would design the Little Cherry Creek Diversion Channel, to the extent practicable, for fish habitat and passage. MMC's survey of the unnamed tributary to Libby Creek that would receive diverted water shows that most of the drainage would develop habitat comparable to Little Cherry Creek (Kline Environmental Research 2005a).

Other components of MMC's fisheries mitigation would include one or more of the following:

- Libby Creek Watershed — Conduct fish investigations to determine the genetics, distribution, and abundance of fishes of concern.
- Howard Lake — Construct paved access trails and three fishing platforms for physically challenged recreationists near existing facilities. Restrooms and other facilities would be modified to improve accessibility. Rehabilitate up to 100 feet of the lake outlet to provide spawning and rearing habitat, using pool-riffle control structures, overhead cover, clean gravels, and proper flow-depth controls.
- Ramsey Lake/Creek — Survey the upper reach of Ramsey Creek and Ramsey Lake for suitability as a trout species of concern fishery, implement habitat and barrier work as necessary, and stock with suitable type and number of fish. Construct a vehicle pullout, small parking area near the mill site accessible to motorized public, and a trail around the Ramsey Plant Site that leads to upper Ramsey Creek or Ramsey Lake.

- Libby Creek — Rehabilitate habitat upstream from the mouth of Howard Creek through creation of pool and hiding cover habitat, stabilization of old mining spoils, and channel narrowing; enhance habitat values in stream reach immediately downstream of the Libby Adit Site.
- Libby Creek Watershed — Conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks.
- Standard Creek — Survey upper reaches for rehabilitation opportunities. Implement habitat work to mitigate limiting factors. Stock with a trout species of concern. Construct an artificial fish barrier protection if needed.
- Snowshoe Creek — Survey upper reach for channel stabilization and habitat rehabilitation needs. Implement habitat and streambank work as needed to mitigate limiting factors. Stock with a trout species of concern. Liming of watershed to speedup recovery of an aquatic ecosystem may be required.
- Kilbrennan Lake—Rehabilitate the fish population in the watershed to create a self-sustaining wild trout population. Implement habitat rehabilitation work as needed based on a survey.

MMC would be responsible for maintenance of all fisheries mitigation projects until mitigation of fisheries losses were complete and accepted by the lead agencies. MMC would submit project surveys and designs for consultation and agencies' approval before implementation of any fisheries mitigation project. Five years of monitoring data indicating stable or increasing mitigation success would be required.

2.4.6.3 Grizzly Bear Mitigation Plan

The Montanore Project would affect existing grizzly bear habitat (see section 3.24.5.3, *Grizzly Bear*). The KNF's 1993 ROD revised the grizzly bear mitigation outlined in the 1992 Final EIS, and adopted the USFWS recommendation of a "reasonable and prudent" alternative identified in a 1993 Biological Opinion for the project. The USFWS' reasonable and prudent alternative is the basis for MMC's grizzly bear mitigation plan. The plan consists of habitat protection, measures to reduce mortality risks, and mitigation plan management.

2.4.6.3.1 Habitat Protection

Habitat protection would consist of three parts: road management, habitat acquisition, and management of patented mill claims. Each part is discussed briefly below. As part of its mitigation, MMC would request that the KNF implement access changes on the following two roads:

- NFS road #4784 (upper Bear Creek Road) would be closed year-long for the life of the project. The change would be at the location of the existing seasonal gate, which is 2.1 miles from the end of the road.
- NFS road #4724 (South Fork Miller Creek) would be closed on a seasonal basis (April 1 to June 30) for the life of the project. The change (6.6 miles) would be at the junction of the main Miller Creek NFS road #385.

MMC would purchase 2,826 acres of private lands to mitigate for habitat losses not offset by KNF's road access changes. MMC would complete all acquisitions within a 6-year period, beginning at the time of construction, with at least 50 percent completed within the first 3 years. Acquired lands would be approved by the KNF, in consultation with the USFWS and FWP. The location of acquired lands would be within the Cabinet portion of the Cabinet-Yaak Ecosystem. Preference would be given for lands within the affected Bear Management Units and lands along the eastern side of the Cabinet Mountains. For biological reasons, and because of the potentially limited amount of lands that may be available for acquisition within this area, lands within other portions of the Cabinet Mountain area of the Cabinet-Yaak Ecosystem may be considered. Any of the following could occur with the acquired parcels, including mill site or mining claims that MMC might patent as a result of the Montanore Project:

1. MMC may purchase the private parcels directly, and then transfer title to the KNF or other state or federal resource management lead agencies. If the KNF acquired these lands, they would be managed as Management Situation 1 grizzly bear habitat.
2. MMC may purchase the private parcels directly, and then transfer title to a private conservation organization, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.
3. MMC may purchase private lands directly, and then retain title to the lands, along with an acceptable conservation easement directed at protecting the land for use by grizzly bears.
4. In some instances, MMC may purchase a conservation easement with fee title remaining with the private party. Conservation easements generally would be established in perpetuity.

The KNF may, on a case-to-case basis and in cooperation with the USFWS and the FWP, accept conservation easements established for a fixed period of time extending throughout the life of the impacts. KNF would be given a chance to purchase the land before offering fee title of acquired lands to third parties. The KNF would seek a mineral withdrawal on any acquired lands to prevent future mineral entry. Under certain conditions, MMC might also be able to enter into a land exchange with the KNF, and in return receive lands outside of grizzly bear habitat. After the KNF, in counsel with the USFWS and the FWP, determines that project impacts have ended, the acquired lands could be used by others seeking mitigation for effects on grizzly bears, providing that acceptable conservation easements or other conditions are satisfied to protect these lands for use by grizzly bears.

Prior to construction activities, MMC would provide a $6,217,200 bond (based on $2,000 per acre) to the Forest Service to ensure adequate funding would be available for the required land acquisition. The bond would take into account any lands that MMC might have purchased prior to construction, providing that the Forest Service, in counsel with USFWS and the FWP, accepted such lands for mitigation. In the event that MMC forfeits the surety bond, MMC would be responsible for all legal fees incurred by the Forest Service. Completion of the acquisition program would be a provision of project approval and failure to comply could result in project shutdown. The bond would be reviewed annually to determine if the bond amount should be adjusted.

2.4.6.3.2 Measures to Reduce Mortality Risks

MMC would fund two new full-time wildlife positions, a law enforcement officer, and an information and education specialist, with duties aimed directly at minimizing effects on grizzly

bears. The estimated total cost would be about $3.1 million over the life of the project. MMC would fund both positions on an annual basis and coordinate with the employing agency to establish a collection agreement. In the future, if additional mines were developed in the Cabinet-Yaak Ecosystem, funding for both positions may be shared by other mining companies.

Duties of the law enforcement officer would be established by the KNF in counsel with the USFWS and FWP, and would be focused toward those enforcement activities needed to: (1) deter illegal killing of bears; (2) investigate reported/suspected bear deaths and help prosecute illegal actions; (3) minimize/eliminate mortality due to mistaken identity during black bear hunting seasons; (4) enforce applicable federal and state laws, regulations, and policy/guidelines regarding proper sanitation practices and elimination of bear attractants; and (5) enforce road access changes and help prosecute violations of road access changes and vandalism. Similarly, the duties of the information and education specialist would focus on: (1) education of school-age children regarding grizzly bear conservation; (2) development of educational materials and programs oriented toward mine employees; (3) implementation of informational/educational materials and programs oriented toward the general public and local community; and (4) integrating with the actions and programs of the Interagency Grizzly Bear Committee and its Subcommittees.

MMC would take additional measures to reduce mortality risk, including the following:

- Request the KNF restrict public motorized travel in upper Ramsey Creek
- Report road-killed animals to FWP as soon as road-killed animals were observed; FWP would either remove road-killed animals or direct MMC how to dispose of them
- Prohibit MMC employees from carrying firearms into permit areas
- Bear-proof all garbage containers
- Prohibit the feeding of bears and leaving of food or other bear attractants in the field

2.4.6.3.3 Plan Management

The KNF would prioritize and direct the land acquisition of the grizzly bear habitat preservation program. MMC would be responsible for carrying out the acquisition program, either directly or through contract with a third party. The KNF's duties in overseeing the mitigation plan would be as follows:

- Prioritize and direct the land acquisition and grizzly bear habitat preservation program
- Evaluate proposals and approve specific habitat enhancement projects for acquired lands
- Review MMC's annual progress reports on the status of the mitigation program
- Direct the Information and Education program, and determine if the program were needed after 5 years or if the program's funds should be redirected to other mitigation needs
- Evaluate the effectiveness of reclamation and determine if and when access changes on roads as part of the mitigation could be reversed, and the specific timing for releasing acquired lands

- The Forest Service, in counsel with the USFWS and the FWP, would be responsible for approval of each acquisition prior to purchase and approval of conservation easements

2.4.6.4 Hard Rock Mining Impact Plan

MMC submitted to Lincoln County an update of the Hard Rock Mining Impact Plan that Lincoln County approved in 1991. The plan describes how the Montanore Project would affect local government services, facilities, costs, and revenues. The plan specifies the measures MMC would undertake to mitigate adverse fiscal impacts to local governments. MMC would prepay about $180,000 in taxes before construction to offset the net negative fiscal impact to the county budget during the first year. Lincoln County approved the updated plan in 2007. Because the Montanore Project as currently proposed would change employment projections, MMC submitted a petition for an amendment for consideration by the Hard Rock Mining Impact Board (Klepfer Mining Service 2008b). The Board approved the petition for amendment in 2008.

2.5 Alternative 3—Agency Mitigated Poorman Impoundment Alternative

2.5.1 Issues Addressed

Alternative 3 would incorporate modifications and mitigating measures proposed by the agencies to reduce or eliminate adverse environmental impacts. These measures are in addition to or instead of the mitigations proposed by MMC. Proposed modifications have been developed in response to the issues identified during the scoping process (ERO Resources Corp. 2006a).

In Alternative 3, four major mine facilities would be located in alternate locations. MMC would develop the Poorman Tailings Impoundment Site north of Poorman Creek for tailings disposal, use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed operating permit and disturbance areas at LAD Areas 1 and 2 to avoid important resources (Figure 22). The issues addressed by the modifications and mitigation measures are summarized in Table 13.

In Alternative 2, MMC's proposed tailings impoundment would be in Little Cherry Creek, a perennial stream, and the impoundment would require the permanent diversion of the upper watershed of Little Cherry Creek. Numerous wetlands and springs are in the Little Cherry Creek Impoundment Site. The lead agencies completed an alternatives analysis and evaluated numerous tailings impoundment sites. The sites considered for an impoundment are described in the section 2.13.2.4, *Tailings Impoundment*. The Poorman Impoundment Site was retained for detailed analysis because it would avoid the diversion of a perennial stream (Issue 2), and the loss of aquatic habitat (Issue 3), and would minimize wetland effects (Issue 7). Additional site comparisons between Alternatives 2 and 3 tailings facilities are presented in section 3.9.3.3, *Little Cherry Creek (Alternatives 2 and 4) and Poorman (Alternative 3) Tailings Site Comparison*.

Similarly, the lead agencies considered numerous sites for locating the plant site (see section 2.13.2.3, *Plant Site and Adits*). MMC's proposed plant site in the upper Ramsey Creek drainage would affect RHCAs (Issue 3), core grizzly bear habitat (Issue 5), and Inventoried Roadless Areas (IRAs). An alternative plant site on a ridge separating Libby and Ramsey creeks was retained for

detailed analysis to address these issues. Preliminary evaluation indicates the Libby Plant Site could be built of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction. Avoiding the use of waste rock in plant site construction would address (acid rock drainage and metal leaching (Issue 1). To avoid disturbance in the upper Ramsey Creek drainage, the adits in Alternative 3 would be in the upper Libby Creek drainage. This modification would address the same issues as the alternate plant site (Issues 3 and 5).

Table 13. Response of Alternative 3 Modifications and Mitigations to Issues.

Key Issue	Mine Plan	Tailings Storage	Water Use and Manage-ment	Reclamation	Monitoring and Mitigation Plans
Issue 1-Acid Rock Drainage and Metal Leaching	✓		✓		✓
Issue 2-Water Quality and Quantity	✓	✓	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓		✓
Issue 4-Visual Resources	✓	✓		✓	
Issue 5-Threatened or Endangered Species	✓	✓		✓	✓
Issue 6-Wildlife	✓	✓		✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.	✓	✓	✓	✓	✓

MMC's proposed LAD Area 1 would disturb RHCAs (Issue 3), old growth (Issue 6) and IRAs; LAD Area 2 would disturb old growth. In Alternative 3, the lead agencies modified the permit areas and disturbance areas for the LAD Areas to address these issues (Figure 22).

In Alternative 2, MMC would discharge mine and adit wastewater from the Ramsey Adits at two LAD Areas. Wastewater would be treated at the Libby Adit Water Treatment Plant or a water treatment plant at the Ramsey Plant Site if necessary to meet discharge limitations. The lead agencies modified the proposed water management plan to address the uncertainties about quality of the mine and adit inflows, the effectiveness of LAD for primary treatment, quantity of water that the LAD Areas would be capable of receiving, and the effect on surface and ground water quality. In Alternative 3, MMC would use either the Libby Adit Water Treatment Plant and/or a water treatment plant at the Libby Plant Site to treat prior to discharge. These modifications would address Issue 2, water quality and quantity.

The modifications and proposed mitigations that comprise Alternative 3 are described in the following sections. All other aspects of MMC's mine proposal would remain as described in Alternative 2. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts. Many of the modifications and mitigations also would carry over into Alternative 4. MMC would submit a final Plan of Operations after final design, including all monitoring and mitigation plans, to the

KNF for approval. MMC would submit a final application for a modification of Operating Permit #00150, including all monitoring and mitigation plans, to the DEQ for approval.

2.5.2 Evaluation Phase

2.5.2.1 Objectives

As described in Chapter 1, MMI acquired the DEQ Operating Permit #00150, private land at the Libby Adit Site and in the Little Cherry Creek drainage, and water rights previously held by Noranda (now Montanore Minerals Corporation). In 2006, MMI proposed and received approval from the DEQ for two minor revisions to DEQ Operating Permit #00150. The revisions involved reopening the Libby Adit and re-initiating the evaluation drilling program that Noranda began in 1989. A description of DEQ Operating Permit #00150 is provided in Chapter 1. The KNF determined the activities associated with the Libby Adit evaluation drilling were a new Plan of Operations under the Federal Locatable Minerals Regulations (36 CFR 228 Subpart A), and MMC needed KNF approval prior to dewatering and continuing excavation, drilling, and development work at the Libby Adit. Under the authority of Minor Revision 06-002 of the DEQ operating permit, MMC has installed a water treatment plant and is allowed to treat free flowing water from the adit.

In 2006, the KNF initiated a NEPA analysis that included public scoping for the proposed road use and evaluation drilling at the Libby Adit Site. In 2008, the KNF decided the best approach for disclosing the environmental effects of the Libby Adit evaluation program was to consider this activity as the initial phase for the overall Montanore Project EIS. The Libby Adit evaluation program would be the first phase of the Montanore Project in Alternatives 3 and 4. The objectives of the evaluation program would be to:

- Expand the known higher grade zones of the deposit
- Develop additional information about the deposit to support a bankable feasibility study
- Assess and define the mineralized zone that extends beyond the current resource boundary
- Provide additional data for geotechnical, hydrological, and other information required to complete a final, bankable feasibility study

2.5.2.2 Proposed Activities

The evaluation drilling program is designed to delineate the first 5 years of planned production. An estimated 35,000 feet of primary drilling and 12,800 feet of infill drilling are planned. The drill core would be used to support resource modeling, mine planning, metallurgical testing, preliminary hydrology assessment, and rock mechanic studies for the full Montanore Project. If adit closure and site reclamation were necessary after completion of the evaluation drilling program, MMC would install a concrete-reinforced hydraulic plug in bedrock, reconstruct the original adit plug, remove all surface facilities, and regrade and revegetate the disturbed areas. Additional information about the evaluation drilling program and site operations and reclamation can be found in MMC's *Notification to Resume Suspended Exploration and Drilling Activities for the Montanore Project, Revision 2* (MMC 2006), on file with the lead agencies.

The Libby Adit would be rehabilitated and the drift extended 3,300 feet. An additional 7,100 feet including the 16 drill stations would be developed under the currently defined ore zones. An estimated 256,000 tons (174,000 cubic yards) of waste rock would be generated and stored on private land at the Libby Adit site. The waste rock storage areas would be lined to collect runoff from the area and seepage through the waste rock. A sump would be located at the toe of the pile where runoff and seepage would be collected and pumped up to the water treatment plant. MMC would implement two monitoring programs to assess water quality of runoff and seepage from waste rock. These two programs would be a waste rock test pad and waste rock column tests. The information collected by these tests would assist the agencies in determining if the full facility would be lined as proposed in this plan. MMC would submit the information and a request to modify the plan if lining was not needed to meet effluent limits. MMC would install a small lined test an area near the top of the waste rock storage area near the area. Initial development rock from the Libby Adit would be placed onto a lined area. A sump would be constructed that would collect any runoff and seepage from the waste rock and pump it back through the water treatment plant and the treated water would be discharged in one of the three permitted MPDES outfalls. Runoff and seepage from the waste rock pile would be analyzed for metals and nitrate, consistent with the MPDES permit monitoring requirements. In the waste rock column tests, MMC would collect samples at the face prior to material being removed for disposal on the lined facility. The objective of the nitrate test would be to determine the amount of residual nitrate/ammonia that remains in the waste rock; metal analyses also could be completed.

The Libby Adit would be dewatered and water would be treated prior to discharging to one of three permitted outfalls. Water quality discharge parameters have been set in MMC's MPDES permit MT-0030279. This permit regulates wastewater discharges from the Libby Adit, and sets effluent discharge quality for both surface and ground water. Treated waters would be discharged to a percolation pond located at the Libby Adit Site. Some of the downstream surface water quality monitoring stations used in assessing effects of the discharges would be located on the National Forest System lands.

The underground evaluation program is anticipated to last 18 to 24 months. MMC would employ 30 to 35 people at the Libby Site and would work two 10-hour shifts 7 days per week. The hours of operation would fluctuate based on daily requirements, but would operate 7 days per week.

Supporting surface facilities are located on private lands at the Libby Adit Site and include an office, shop, generators, waste rock stockpile, and other ancillary facilities. All of the proposed underground work, except for the portal area, is within the KNF. Power to the Libby Adit would be supplied by up to four 850-kw propane generators. The generators would be supplied by a third party contractor, which would provide the generators and be responsible for holding an air quality permit for them.

MMC would use Libby Creek Road, NFS road #231, and Upper Libby Creek Road (NFS road #2316) as the primary year around access to the surface facilities at the Libby Adit Site. These roads would be snow plowed to allow access during winter.

2.5.2.3 Reclamation

MMC may retain the dewatering pumps and operation of the treatment plant beyond the evaluation program. Dewatering and water treatment would continue until a bedrock portal plug was installed. As part of permanent closure and site reclamation, a portal plug would be installed in bedrock near the bedrock/colluvial contact point 600 feet from the portal opening. To ensure

long-term stability, waste material would be backfilled into the adit from the bedrock plug out to the surface opening where another plug would be re-installed as originally designed. One this surface plug is installed excavated material would be placed back over the portal plug and general opening and regraded to match the surrounding topography. Other surface features, such as the waste rock stockpiles and the percolation pond would be regraded. All surface facilities, buildings, power supply and equipment would be removed. The stockpiled 18 inches of soil would be placed over the regraded and scarified areas. The disturbed sites would be reseeded.

2.5.2.4 Agency Mitigation

The KNF developed specific design features and mitigation for the evaluation phase of the project. These measures are common to both Alternative 3 and Alternative 4 and would be implemented prior to dewatering the Libby Adit and beginning any underground activities. The fisheries mitigation measures for the evaluation phase are described in section 2.5.7.2.1, *Access Road Use*. Mitigation for wildlife is incorporated into the overall wildlife mitigation plan (see section 2.5.7.3.1, *Grizzly Bear*); italicized item listed in section 2.5.7.3.1, *Grizzly Bear* would be implemented prior to the evaluation program. The design features and mitigation measures are for the evaluation phase of the Libby Adit would remain in place for the life of the Montanore Project. MMC would implement the all other design features and mitigation for the full Montanore Project prior to beginning the construction phase of the mine. The hydrology monitoring during the evaluation phase is described in Appendix C.

2.5.3 Construction Phase

2.5.3.1 Permit and Disturbance Areas

All operating permit disturbance area boundaries would be marked in the field with fenceposts and signed to limit potential disturbance outside permitted disturbance areas. The operating permit area would total 2,606 acres and the disturbance area would total 2,011 acres (Table 14).

In Alternatives 3 and 4, MMC would complete before final design and any ground-disturbing activities an intensive cultural resources survey and a jurisdictional wetland delineation on all areas proposed for disturbance for any areas where such surveys have not been completed and that would be disturbed by the alternative. Similarly, MMC would complete a survey for threatened, endangered, and Forest and state sensitive plant species on National Forest System lands for any areas where such surveys have not been completed and that would be disturbed by the alternative. The surveys would be submitted to the agencies for review and comment. If adverse effects could not be avoided, MMC would develop appropriate mitigation plans for the agencies' approval. The mitigation would be implemented before any ground-disturbing activities.

2.5.3.2 Vegetation Clearing and Soil Salvage and Handling Plan

During final design, MMC would submit a final Soil Salvage and Handling Plan to the lead agencies for approval. The plan would include means to ensure that the necessary amount of suitable soil was salvaged in disturbed areas, that soils would be stockpiled and redistributed properly, and that losses from handling and erosion on stockpiles and in reclaimed areas would be minimized. Also, the timing and sequencing of stockpile use (for respreading) would be detailed to ensure that visual impacts would be mitigated, and that direct-haul methods would be maximized.

Table 14. Mine Surface Area Disturbance and Operating Permit Areas, Alternative 3.

Facility	Disturbance Area† (acres)	Permit Area (acres)
Existing Libby Adit	22	219
Upper Libby Adit	1	1
Rock Lake Ventilation Adit	1	1
Libby Plant Site and Adits	110	172
Poorman Tailings Impoundment	1,359	1,585
Poorman Tailings Impoundment and Seepage Collection Pond	608	
Borrow areas outside impoundment footprint	92	
Soil stockpiles	48	
Other potential disturbance (roads, storage areas, ditches, etc.)	617	
LAD Area 1	260	277
LAD Area 2	123	196
Access Roads†		
Bear Creek Road (NFS road #278 from U.S. 2 to Tailings Impoundment)	90	0
Tailings Impoundment permit area to LAD Areas 1 and 2 (NFS roads 2317 and #4781, existing NFS road #278, and new NFS road #278)	19	74
LAD Areas to Libby Plant Site (NFS road #4781 and #6210)	17	70
Libby Plant Site to Libby Adit Site and Upper Libby Adit Site (NFS roads #6210 and #2316)	9	11
Total	2,011	2,606

†Disturbance area shown for roads excludes 33 feet of existing disturbance along roads.

2.5.3.2.1 Vegetation Removal and Disposition

As part of final design, MMC would prepare a Vegetation Removal and Disposition Plan for the agencies' approval. The plan would evaluate the potential uses of vegetation removed from disturbed areas, and describe disposition and storage plans during mine life. It also would address vegetation removal along the transmission line (see transmission line Alternatives C, D, and E), with the goal of minimizing tree and other vegetation clearing.

Because of observed metal leaching problems and low pH seepage from soil stockpiles containing large amounts of coniferous vegetation at other mine sites in Montana, the majority of coniferous forest debris would be removed before soil removal. Merchantable timber would be measured, purchased from the KNF, and then cleared before soil removal. Non-merchantable trees, coniferous forest debris, and slash from vegetation clearing in the mine disturbance areas and along the transmission line would be managed in accordance with Montana law regarding reduction of slash (76-13-407, MCA) and, on National Forest System lands, KNF objectives regarding fuels reduction. Excess slash would be removed or burned in all timber clearing areas

and within 0.5 mile of any residence. Slash management on Plum Creek and other private lands not owned by MMC would be in accordance with Montana law and the landowner/MMC easement agreement. Non-merchantable trees and coniferous forest debris would be removed using a brush blade or excavator to minimize soil accumulation. MMC would comply with open burning requirements. Where possible, slash of non-coniferous forest debris or dead coniferous forest snags would be salvaged and chipped to be sold, used as mulch, or used as an additive to stored soil. Large woody debris would be used in instream structures proposed in the fisheries mitigation plan. All mulching materials would be certified weed-seed free.

2.5.3.2.2 Soil Salvage

MMC would salvage soils in all disturbed areas, with the exception of slopes exceeding 50 percent and soil stockpiles. Suitability of soils proposed for reclamation was determined from physical and chemical data collected during the baseline soils survey. Soils would be salvaged in two lifts in the tailings impoundment site, borrow areas, Libby Plant Site, and LAD Areas. The first lift would include the relatively organic-rich surface layers (topsoil), and the second lift would include the subsoil immediately below the topsoil to a depth based on need and suitability. At road disturbances, soils would be salvaged in one lift. Soils with more than 50 percent rock fragment generally would not be salvaged. Soils with rock fragment contents up to 60 percent by volume would be salvaged in some areas to provide erosion protection on the tailings impoundment embankments.

2.5.3.2.3 Soil Stockpiles

Most soils would be stockpiled as close as possible to redistribution sites. Soil stockpiles would be constructed with 40 percent side slopes and 33 percent sloping ramps, where possible. The two-lift salvage program would segregate according to soil erodibility (*i.e.*, rock fragment content) and first lift versus second lift. For example, glaciolacustrine soils, having the greatest erodibility and few rock fragments, would be stockpiled separately from first lift materials that contain a large amount of rock fragments, and second-lift glaciolacustrine clay-rich soils would be stockpiled separately from other second-lift soils. The stockpiles would be signed, based on the use in the post-mining landscape.

In Alternative 2, MMC proposes to stabilize soil stockpiles when they reach their design capacity and seed during the first appropriate season following stockpiling. In Alternatives 3 and 4, MMC would incrementally stabilize soil stockpiles (rather than waiting until the design capacity was reached) to reduce erosion and maintain soil biological activity in the surface. Seeding should be done as soon after disturbance as possible rather than waiting until the next appropriate season. Immediate seeding of road cuts-and-fills would reduce erosion on Forest Service roads regardless of planting time. To the extent possible, MMC would stockpile soils in clearings or recent timber harvest areas that were immediately adjacent to new roads, which would be operational for mine life, rather than stockpiling along the entire road corridor.

Soil stockpiles would have organic matter and fertilizer added to help retain soil quality and promote successful revegetation. Noxious weeds on stockpiles would be controlled throughout the stockpile life, and sprayed before soil redistribution.

MMC would report soil stockpile volumes and disturbance acres in each annual report to the lead agencies. MMC would prepare an annual soil reconciliation report to document that the soils in stockpiles were sufficient to reclaim the current disturbed acres. If a shortfall existed, MMC would submit a plan to make up for the soil shortfall in the following year.

2.5.3.2.4 Soil Replacement and Handling

MMC would replace soils in all disturbed areas, with the exception of soil stockpiles and cut slopes in consolidated material. In Alternative 2, MMC proposed to redistribute 24 inches of soil on the embankment of the tailings impoundment in two lifts: 15 inches of rocky subsoil on the bottom followed by 9 inches of topsoil on the top. Replaced soils depths on other disturbed areas would be 18 inches including the top of the tailings impoundment. Other reclaimed sites in Montana have shown that 24 inches of replaced soil provides sufficient rooting depth (Plantenberg, pers. comm. 2006). In Alternatives 3 and 4, where redistributed soils cover non-native material, the replaced soil depth would average 24 inches using two lifts, including over the entire tailings impoundment. If any waste rock stockpiles remained at the end of mining, and depending upon acid generation or near neutral metal leaching potential and size and amount of rock fragments, 24 inches of replaced soil in two lifts may be needed to provide sufficient rooting depth. Soils replacement depths at other disturbances where soil is to be replaced, except road disturbances, would be 18 inches and would be applied in two lifts. If MMC demonstrated through test plots that site-specific soils would provide sufficient root zone and revegetation success at thinner applications, the thickness could be reduced at the lead agencies' concurrence.

Soils in the impoundment area would be replaced based on soil erodibility and slope steepness. For example, the least erodible colluvial/glacial soils having the greatest rock fragment content for both first lift and second lift soils, would be used on the impoundment face to minimize erosion potential. The soils with the greatest erodibility, primarily glaciolacustrine soils, would be used on slopes less than 8 percent, such as the relatively flat tailings impoundment surface. Soil salvage and redistribution would occur throughout the life of the mine operation. Soils should be handled and worked at the minimal moisture content to reduce the risk of compaction and tire rutting.

Disturbed areas, such as parking areas, roads, adit portal areas, top of the tailings impoundment, and building sites would be ripped to 18 inches deep with dozer ripping teeth prior to soil replacement to reduce any root zone barriers due to compaction and to facilitate storm water infiltration after reclamation. Any disturbed area to be seeded would be scarified to a depth of 6 to 12 inches prior to seeding for best seed establishment. All disturbed areas would be seeded, fertilized, and mulched as necessary. Where soil fertility may be low and tilth poor, organic matter (weed-free agencies-approved wood-based compost) would be incorporated into respread soils before planting. All permanent cut and fill slopes on roads would be seeded, fertilized, and stabilized with hydromulch, netting, or by other methods.

Mycorrhizae, which are structures in the soil important in maximizing plant establishment and productivity, especially for woody plants, are eliminated in soil stored for prolonged periods. In reclaimed areas where trees would be planted, an agencies-approved wood-based compost would be incorporated into the upper 6 inches of respread soil that had been stored for prolonged periods to promote the rebuilding of mycorrhizae in the soil (Plantenberg, pers. comm. 2006), and/or inoculated tree-planting stock with the appropriate mycorrhizal fungi would be used, or mycorrhizal fungi would be incorporated into the soil as pellets during seeding. Additional nitrogen fertilizer may be needed to compensate for wood-based mulch.

2.5.3.2.5 Direct Haul and Temporary Storage of Soil

Direct haul soil salvage and replacement would be required for use whenever, and as much as possible, to enhance revegetation success of native unseeded species (Prodgers and Keck 1996 *In*

USDA Forest Services and DEQ 2001). Direct haul would be done primarily at the tailings impoundment.

Areas such as road cut-and-fill slopes, transmission line structure locations and access roads, and other disturbances that would remain post-mine should be reclaimed as soon as final grades were achieved with direct haul soil or soil that had been stockpiled for less than 1 year. This would increase the chances of direct transplantation and propagation of many of the local ecotypes on the reclaimed surface (Prodgers and Keck 1996 *In* USDA Forest Services and DEQ 2001).

2.5.3.3 Libby Plant Site and Adits

Pre-production development would be similar to Alternative 2, but the Libby Plant Site would be located on a ridge separating Libby and Ramsey creeks (Figure 25). The same facilities proposed for the Ramsey Plant Site (Figure 5) would be built at the Libby Plant Site. Access to the plant site would be via NFS roads #2316 and #6210. A permanent bridge would be constructed across Ramsey Creek to provide access to NFS road #6210 from the Ramsey Creek Road. The bridge would be built in compliance with the INFS standards and guidelines (USDA Forest Service 1995). Soil from the Libby Plant Site would be salvaged and stored in a stockpile in a timber harvest area along NFS road #14403.

In Alternative 3, four adits would be required for the project, similar to Alternative 2. The two Ramsey Adits would be relocated into the Libby Creek drainage area (Figure 25). The ventilation adit located near Rock Lake proposed in Alternative 2 would remain the same (Figure 4) and the existing Libby Adit would be enlarged. The relocation of the Ramsey adits would not significantly alter the targeted access points into the deposit (crusher area, etc.) as proposed in Alternative 2.

The existing Libby Adit would be enlarged to about 30 feet wide by 30 feet high. An additional adit would be constructed on MMC's private land near the existing Libby portal and would be 17,000 to 18,000 feet long and decline to the ore body at 5 percent grade, depending on the portal location selected. These two adits would serve the same function as the two Ramsey Adits with one adit containing the underground conveyor and the other used for personnel access and material delivery into the mine. The exact location of the second adit on private land has not been determined. Two options for this adit portal have been identified.

A third adit (Upper Libby Adit), upstream of the Libby Adit Site, would provide ventilation and emergency access. This adit would be 13,700 feet long, and decline to the ore body at about a 7 percent grade. To the extent feasible, the Upper Libby Adit would be constructed from underground, and waste rock hauled out of the Libby Adit Site, and not the Upper Libby Adit site.

Ore would be conveyed via an above-ground covered conveyor from the Libby Adit Site 6,000 and 7,500 feet to the covered coarse ore stockpile at the Libby Plant Site. The conveyor would parallel NFS roads #2316 and #6210. The agencies identified two options for the conveyor: one would be about 10 feet wide and 10 feet high, and the other would be lower (8 feet), but wider (16 feet) (Figure 24). The conveyor would be designed to minimize contact with precipitation and loss of ore. A "wraparound" conveyor would achieve these objectives and would eliminate the need for a transfer point at the intersection of NFS roads #2316 and #6210. A completely enclosed conveyor may also be used. Any spillage would be promptly cleaned up to avoid contact with precipitation.

Geotechnical investigations of the Libby Plant Site have not been completed. If the depth to bedrock at the site were similar to the Libby Adit Site or LAD Area 1, preliminary evaluation indicates the Libby Plant Site could be built out of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction. Consequently, the fill slopes at the plant site would not be subject to the ELGs, and a MPDES outfall would not be needed at the site.

Electrical power would be the same as Alternative 2. Electrical power during the initial preproduction phase would be supplied by two 1,250-kW diesel generators located at the Libby Adit, same as Alternative 2. A buried 34.5-kV transmission line along Bear Creek Road and the Libby Plant Access Road may be installed to replace the generators prior to the installation of the main transmission line. If the buried 34.5-kV line were installed, the generators would be used as standby power during construction operations. To provide power to the Libby Adit activities, a temporary substation would be installed near the intersection of NFS road #6210 and the Libby Plant Site Access Road (Figure 7). If constructed, the 34.5-kV line along Bear Creek Road and the Libby Plant Access Road would connect to this substation. Power would be distributed from the temporary substation to the Libby Adit Site and Libby Plant Site.

2.5.3.4 Waste Rock Management

Waste rock developed extending the Upper Libby Adit and the new Libby Adit would be hauled to a waste rock stockpile within the Poorman Tailings Impoundment footprint, the location of which would be determined during final design. As part of the Libby Adit evaluation program, MMC would complete a test of water that infiltrated and ran off of the waste rock stockpile at the Libby Adit Site (see section 2.5.2, *Evaluation Phase*). This testing was a condition in DEQ's approval of Minor Revision 06-002. If monitoring results or other waste rock testing indicated water treatment would not be necessary, a retention pond sized to store a 10-year/24-hour storm would retain any runoff. The Seepage Collection Pond or the Starter Dam may serve this purpose if they were constructed before waste rock generation. If monitoring results or other waste rock testing indicate treatment would be necessary, the waste rock stockpile would be lined with clay or a geomembrane to achieve a permeability of less than or equal to 10-6 cm/sec. MMC would provide a stability analysis if the area were lined. If treatment were necessary, collected water would be pumped to the water treatment facility at the Libby Adit.

A waste rock sampling plan is described in MMC's waste rock management plan (Geomatrix 2007b). In addition to the management, sampling, and analysis described in the plan, MMC in Alternative 3 would:

- Segregate potentially acid-generating materials or materials with the potential to leach metals at a near neutral pH from portions of the lower Revett and Prichard Formations for additional kinetic and metal mobility testing and provide for selective handling as indicated by test results
- Isolate and place such materials under sufficient cover to minimize direct exposure to the atmosphere and precipitation until geochemical test work was complete
- Conduct sampling to represent the mineralized alteration haloes within the lower Revett, and the portions of the Burke and Wallace formations to supplement limited baseline data (Alteration haloes are zones of changed mineralogy that occur around the ore deposit, containing chalcopyrite-calcite, pyrite-calcite, and galena-calcite mineralization)

- Conduct operational verification sampling within the Prichard Formation during development of the new adits
- Use static acid-base potential analyses with kinetic test data to identify operationally achievable handling criteria and to guide waste management
- In addition to analysis for acid-base potential, conduct analyses to assess the magnitude of trace metal release for waste rock at a near neutral pH
- Complete additional characterization of trace metal release potential for tailings once more representative bulk samples were obtained during mine development work
- Conduct additional sampling and analysis of barren zone to evaluate its potential to generate acid and or release elevated lead concentrations

2.5.3.5 Tailings Management

The agencies developed the Poorman Impoundment Site as an alternative because it would avoid the diversion of Little Cherry Creek, reduce the loss of aquatic habitat, and would minimize wetland effects. The Poorman Impoundment Site would not provide sufficient capacity for 120 million tons of tailings without a substantial increase in the starter dam crest elevation if tailings were deposited at a density proposed in Alternative 2. The tailings thickener requirements to achieve higher tailings slurry density (and hence higher average in-place tailings density) are uncertain without additional testing of simulated tailings materials. Such testing would be completed during the Libby Adit evaluation program. These issues and the development of the Poorman Impoundment Site for tailings disposal are discussed in the following sections. Additional site comparisons between Alternatives 2 and 3 tailings facilities are presented in section 3.9.3.3, *Little Cherry Creek (Alternatives 2 and 4) and Poorman (Alternative 3) Tailings Site Comparison*.

2.5.3.5.1 Tailings Deposition Methods

Tailings management depends on the amount of solution or water mixed into or removed from the tailings, *i.e.*, the slurry density, for purposes of deposition. The most appropriate method of tailings management for a given project depends on several factors including tailings characteristics, tailings disposal site conditions, and project-specific factors such as production rates, environmental constraints such as shallow depth to water table and unstable foundation conditions, and distance from the ore processing mill to the tailings disposal site. Tailings disposal methods available under current technologies are listed below along with a typical range of slurry densities associated with each method. Similar values are presented in MMC's operating permit application (Klohn Crippen 2005). Slurry density can vary between methods depending on the physical and geotechnical characteristics of site-specific tailings. Percent slurry density is the ratio of the dry weight of solids in the slurry to the total slurry weight (dry solids weight plus the water weight) for the total tailings stream or any unit measurement of the tailings stream.

- **Slurry Tailings Deposition** – This traditional method of tailings disposal is used at the Troy Mine and proposed by MMC in Alternative 2. Slurry tailings deposition also would be used in Alternative 4. Slurry density is generally 55 percent or less and the slurry is characteristic of a thick or heavy fluid with respect to gravity flow and pumping.

- **Thickened Tailings Deposition** – Slurry density is generally between 55 percent and 65 percent and the slurry is characteristic of a thick batter mix with respect to flow and pumping; deposition is similar to slurry tailings but the solids tend to settle more quickly and form a slightly steeper slope.
- **Paste Tailings Deposition** – Slurry density is between 65 percent and 80 percent and the slurry is characteristic of a thick molten material or gooey "toothpaste" that drains off excess solution upon deposition and creates a steeper tailings slope. Paste tailings with a slurry density in the lower part of this range are sometimes referred to as high-density or highly thickened tailings slurry. Transport to the point of deposition requires special pumping considerations such as the use of positive displacement pumps (similar in concept to concrete pumps). This is the approved method of tailings deposition for the Rock Creek Project.
- **Dewatered Tailings Deposition** – Slurry density is between 80 percent and 83 percent and the slurry is characteristic of a high-slump concrete mix and readily drains off excess solution upon deposition to resemble a very wet soil-like material within a short period of time. Dewatered tailings can be stacked at steeper slopes than paste tailings at deposition.
- **Filter Cake or Dry Deposition** – Slurry density is at or greater than 83 percent and material is handled and deposited as a moist to wet soil material. The moisture content of the tailings at deposition is less than 100 percent saturation.

Deposition of tailings slurries at thicker densities can offer several advantages over slurry tailings at 55 percent or less. The primary advantage is that water recovery increases as part of the process in preparing the thicker slurry densities, thus reducing make-up water requirements and the amount of excess water stored in the impoundment. In addition, high-density tailings and dewatered/filter tailings are generally more dense at deposition and consolidate to a higher density more rapidly than slurry tailings and can be used to create a more stable tailings embankment. As a result of the lower water content and increased density, the shear strength generally increases over slurry tailings. Tailings surface slopes are, therefore, generally steeper and more stable than the slurry tailings. In some cases, this allows for the tailings to be deposited from up gradient slopes at an elevation above the level surface of the tailings. Depending upon the native ground slope, and the impoundment geometry, high-density to dewatered and filtered tailings can be discharged from a higher elevation to create a slope of tailings above the normal impoundment level. Such deposition along with increased density in the placed tailings can be used to develop a deposition plan to reduce the required impoundment capacity, lower the dam crest, and possibly reduce the impoundment footprint.

The Poorman Impoundment Site is amenable to high-density tailings deposition from the upstream perimeter slopes, whereas the Little Cherry Creek site has limited capacity for high-density tailings deposition from slopes upstream of the impoundment. In Alternative 2, the drainage area above the diversion dam on Little Cherry Creek would have to be used for high-density tailings deposition to be beneficial in increasing impoundment storage capacity. The Poorman Impoundment Site could be used for deposition of slurry tailings at a 55 percent slurry density. To hold 120 million tons, the main dam would be 20 feet higher and would require considerably more borrow material to construct for slurry tailings deposition than for high-density tailings deposition. Therefore, high-density tailings deposition is used in the Alternative 3 dam and impoundment layout described in the following paragraphs.

2.5.3.5.2 Final Design Process

The tailings facility design would be based on additional site information obtained during the design process, which would include a preliminary design phase and a final design phase. Site information would be collected under exploration programs for each of the two design phases. A preliminary site exploration program would be completed to confirm the geotechnical suitability of the site should Alternative 3 be selected as the preferred site. The field exploration program would include a site reconnaissance and a drilling and sampling program to evaluate:

- Site geology and foundation conditions
- Ground water conditions and water quality
- Borrow material availability
- Geotechnical characteristics of foundation and borrow materials

Based on these data, a preliminary design of the Alternative 3 site would be completed to confirm the site layout and design/operation feasibility. The second field exploration program would be completed to collect data and material samples necessary for the final design of the facility. In Alternatives 3 and 4, MMC would, during final design:

- Incorporate guidelines from the Idaho Administrative Code Safety of Dam Rules and the California Department of Water Resources, Division of Safety of Dams for seismic stability as appropriate
- Use more recent attenuation relationships that are based on instrumental records of attenuation collected in the United States and internationally (Spudich *et al.* 1999 and Boore *et al.* 1997)
- Complete circular failure plane assessments through the near-dam tailings and dam section and through the dam crest and slope
- Submit final design to the agencies for approval
- Fund a technical review of the final design by a technical review panel established by the lead agencies

Technical review of the final design would be made by a technical review panel established by the lead agencies. The review would encompass the technical aspects of design including the short- and long-term stability of the tailings storage facility. If supplemental rock and tailings characterization data and geochemical testing showed a potential for acid generation not presently anticipated, the review also would include an evaluation of the seepage collection system to ensure that no seepage would reach surface water. The technical review panel would assist in the development of the QA/QC protocols. The panel would ensure that any environmental impacts associated with final design remained within the scope of those impacts identified in the Final EIS. If the final design generated additional impacts and they could not be mitigated, additional MEPA/NEPA documentation may be required. The lead agencies would review and approve the final design prior to construction.

2.5.3.5.3 Poorman Tailings Impoundment Site Location

The conceptual Poorman Tailings Impoundment Site would be located between Little Cherry and Poorman creeks in an ephemeral watershed tributary to Libby Creek could be developed to hold 120 million tons of tailings and support facilities (Figure 26). The site would be entirely on

National Forest System lands. Private property not owned by MMC would be located 300 feet east of the southern two-thirds of the tailings dam alignment. The Poorman site is in Sections 24 and 25, Township 28 North, Range 31 West. Tailings would be transported to the site from a mill as a slurry, the same as proposed by MMC in Alternative 2. At the site, the tailings would be sent to a thickener plant and deposited in the impoundment as high-density tailings.

The Poorman Tailings Impoundment Site is a broad, east-facing slope about 0.25 mile west of Libby Creek. Like the Little Cherry Creek site, ground water beneath the site exhibits artesian pressures in the base of the slopes above Libby Creek (Morrison-Knudsen Engineers, Inc. 1989a). The geology and near surface soils of the site are similar to the materials found in the Little Cherry Creek tailings site (Alternative 2) except that soft weak clays do not appear to be present in the soil strata (Morrison-Knudsen Engineers, Inc. 1989a).

2.5.3.5.4 General Proposed Facilities

In Alternative 3, the cyclone overflow (the fine tailings fraction after the sand is removed to build the sand dam), would be deposited as high-density tailings slurry with an average slurry density of 70 percent. The ability to achieve these densities is discussed in section 3.9.3.3, *Little Cherry Creek (Alternatives 2* and 4) *and Poorman (Alternative 3) Tailings Site Comparison*. The agencies assumed thickening to an 80 percent density for the Rock Creek Project, which is proposing the mine in the same formation as the Montanore Project (see section 3.8.3.1.2, *Alternative 2 – MMC's Proposed Mine* for a discussion of the geologic similarities between the Rock Creek and Montanore deposits). At a 70 percent slurry density, the average settled density of the tailings over the life of the project is estimated to be 85 pounds per cubic foot (pcf). As excess water drains from the fine tailings mass and the mass consolidates under long-term conditions, the average mass density could exceed 90 pcf. The time frame for such consolidation and the final average tailings density would depend upon the characteristics of the tailings and deposition patterns around the impoundment. The tailings slope is estimated to be 5 percent and the tailings shear strength sufficient to remain stable. Laboratory tests would be run to confirm the slurry densification and shear strength characteristics, and seepage-induced consolidated tests would be performed on representative tailings samples to determine the appropriate slurry density, slope at deposition, and expected consolidation behavior of the tailings.

Site development would include site stripping and foundation preparations followed by construction of a Starter Dam built from waste rock and borrow materials (as in Alternative 2), a Rock Toe Berm under the toe of the Main Dam for stability, a drainage system within the impoundment area (as in Alternative 2), a Seepage Collection Pond and associated pumpback well system (as in Alternative 2), a Saddle Dam on the north side of the impoundment, a tailings thickening plant, a waste rock stockpile, topsoil and subsoil stockpile areas, and relocation of NFS road #278.

The tailings dam would consist of three sections, the Starter Dam along the upstream toe of the Main Dam section, a Rock Toe Berm to buttress/support the sand dam along the Main Dam section, and a Main Dam section consisting of the sand fraction cycloned from the tailings (Figure 26 and Figure 27). The dam would have a final crest length of 10,300 feet at an elevation of 3,664 feet. The dam would have a vertical height of 230 feet above the Rock Toe Berm and 360 feet including the Rock Toe Berm. The dam layout is designed to maximize the height of the dam section based on estimated quantities available from the cyclone operations and to minimize fill requirements to balance the fill volume required for the total dam. Based on initial evaluation, the layout is considered feasible, but would be revised in final design, if possible, to reduce total fill quantities.

An impoundment with a Main Dam crest of 3,664 feet would contain almost all of the thickened tailings. With an average in-place density of 85 pcf at completion of tailings deposition (91.4 million tons), about 1 foot of additional dam crest would be required for complete storage of the tailings at a level surface. Assuming a level tailings surface, the impoundment capacity at the estimated dam crest elevation in the final years of operation would not allow for water storage within the impoundment area nor account for lost capacity due to the slope of the tailings surface. The dam maximum crest would be set at about 3,664 feet based on the Starter Dam and Rock Toe Berm layouts and the volume of cyclone sand available for construction of the Main Dam. Perimeter tailings deposition from an elevated position along the back slope of the impoundment would be required to store all of the tailings and allow for water storage within the impoundment during the final years of operation as discussed in subsequent sections. The cross-section shown in Figure 27 shows the estimated height and slope of the tailings surface with deposition from the perimeter slopes.

Foundation Preparations

Foundation preparations would be as described in Alternative 2. Based on limited field data, no unsuitable foundation conditions relative to dam stability are anticipated in the Poorman Site. In the event unsuitable materials were identified in subsequent design studies, or otherwise encountered in the site, such material would be excavated and stored in a stockpile. The material would be used for cover material in closure of the tailings facility or backfilled into borrow areas.

Rock Toe Berm

A Rock Toe Berm would be constructed as a compacted rock fill structure in the toe area of the Main Dam. The Rock Toe Berm is designed to reduce the volume of cyclone sand required to construct the dam to the design height, and limit the height of the sand dam to allow a steeper downstream face to reduce the required sand volume. The Rock Toe Berm would be a free draining structure to prevent build up of a water surface in the toe of the Main Dam. The Rock Toe Berm would have a 30-foot wide crest at an elevation of 3,440 feet with a 2.5H:1V downstream slope and a 3H:1V upstream slope. The upstream face of the Rock Toe Berm would be of screened material to create a surface that is filter compatible with the tailings sand to prevent the tailings sand from migrating into the Rock Toe Berm. The crest length is 4,400 feet and the vertical height at the maximum section is 140 feet. The total estimated volume of the Rock Toe Berm is 2.7 million cubic yards. About 1.2 to 1.5 million cubic yards of waste rock would be available from initial mine development and early mine operations. The balance of material would be obtained from either a rock borrow quarry developed in the upper elevations of the site where soil cover is minimal (Figure 26) or from suitable sand and gravel lenses noted in the glacial deposits located at the site (Morrison-Knudsen Engineers, Inc. 1989a).

Starter and Saddle Dams

The Starter Dam would be a compacted earthfill embankment with a 70-foot wide crest at an elevation of 3,480 feet (Figure 26). Upstream and downstream slopes would be 2.5H:1V. The wide crest was selected to reduce sand requirements in the Main Dam. The estimated crest length is 6,000 feet and the maximum section about 100 feet high. The Starter Dam would be constructed with borrow material excavated from surface and near surface glacial deposits within or adjacent to the impoundment (Figure 26). The conceptual layout volume is estimated to be 1.7 million cubic yards. The fill would be placed in maximum uncompacted lifts of 1 foot or less and compacted with suitable equipment. All boulders larger than 8 inches diameter would be removed from the fill. A Saddle Dam of similar construction would be required in the north perimeter of

the impoundment area. The Saddle Dam volume is estimated to be 730,000 cubic yards. The estimated volume of available borrow within the impoundment area is in excess of 5 million cubic yards. During Starter Dam construction, a temporary water reclaim/storage pond would be constructed upstream from the Starter Dam to hold water until the Starter Dam was complete.

After the Starter and Saddle Dams were constructed, the impoundment footprint would be prepared for tailings deposition after operations began. Any soft, unsuitable materials would be either excavated and transported as backfill for the borrow areas, or filled with suitable material, such as general fill from borrow areas. All wetland soils would be excavated and used at wetland mitigation sites (see section 2.5.7.1, *Wetland Mitigation*). Final design for management of these types of materials would be submitted to the agencies for approval. A high-density, polyethylene (HDPE) geomembrane liner would be placed beneath a portion of the tailings impoundment and keyed into the low permeability zone of the dam (Figure 26 and Figure 27).

Borrow Materials

The primary source for borrow materials for the starter and Saddle Dams would be local borrow materials from within the impoundment footprint (Figure 26). The borrow source for the Rock Toe Berm would be waste rock from the mine stockpiled at the site supplemented by local borrow within or adjacent to the impoundment area. Borrow for the Rock Toe Berm from within the impoundment site would consist of sands and gravels obtained for lenses in the underlying glacial alluvial material or bedrock obtained from a quarry site that could possibly be developed in the higher elevations where soil cover appears to be shallow compared to most of the impoundment area. Ideally, the quarry would be below the proposed relocated access road and within the upper tailings area.

Drain materials would be obtained from on-site crushing and screening of suitable borrow (such as the sand and gravel lenses referenced in the glacial alluvial deposits) or obtained from a commercial source. Table 15 is a summary of anticipated material and volumes based on the conceptual layouts for Alternative 3.

Table 15. Estimated Facility Volumes, Alternative 3.

Facility	Volume (million cubic yards)
Starter Dam	1.7
Rock Toe Berm	2.7
Cyclone Sand Dam	22.2
Saddle Dam	0.7
Seepage Collection Pond Fill	<0.1

2.5.3.5.5 Seepage Collection

In Alternative 3, a seepage collection system similar to that proposed in Alternative 2 would be used. A system of trunk drains and smaller lateral drains over the impoundment floor and beneath the tailings dam would convey seepage to the toe of the dam (Figure 26). Smaller secondary drains would convey water laterally into the trunk drains. It is assumed tailings seepage would be equal to the flow rates estimated for Alternative 2. For example, the estimated seepage flow rate into the foundation below the impoundment is 25 gpm and the seepage water from tailings consolidation is based on 75 percent of consolidation water migrating downward and 25 percent moving upward into the surface pond.

Artesian conditions are present along the toe area of the dam footprint. A drainage collection system would be designed (similar to Alternative 2) and installed under the Rock Toe Berm and extend upstream under the Main and Starter dam footprints as necessary to collect and control ground water. The Rock Toe Berm would be designed as a separate facility, but with its base layer

compatible with the underlying drain system. Design of the ground water drain system in the toe area of the dam would be separate from the tailings impoundment seepage collection system to enable separate monitoring of the two systems prior to discharge into the Seepage Collection Pond. Final design of the ground water drain system would consider the need and benefit of a seepage collection trench along the toe of the dam upstream of the private property (Figure 26).

Drain designs (both gravity and pressure relief drains) would be similar to those used in Alternative 2. Drains within the impoundment would be installed in trenches into the native ground and covered with a permeable protective layer to prevent erosion and plugging of the drains during initial placement of the tailings (Figure 26). During construction of the seepage collection and drain system, any wetlands uphill of the Main Dam would be filled. All drains would be placed in a geomembrane-lined trench and consist of a core of highly pervious 1- to 4-inch rock wrapped in geotextile and surrounded by sand and gravel filter material. Locally available sand and gravel alluvial material would be used to cover the drains to prevent the fine tailings from piping into the drain materials during operations. Seepage collection drains through and under the dam footprint would be designed as integral parts of the dam foundation and compatible with each of the overlying dam sections. MMC has committed to implementing seepage control measures, such as pumpback recovery wells, if required to comply with applicable standards. The pumpback recovery wells would be located beyond the dam toe, and would be designed to collect seepage not collected by the drain system.

A Seepage Collection Pond and return facility would be 500 feet west of Libby Creek, 500 feet downstream of the impoundment. The facility design would include collection of water from the impoundment seepage collection drains, the ground water relief drains, and runoff from the downstream slope and toe area of the tailings dam facility. The pond would have a crest elevation of 3,240 feet and be lined with HDPE (or equivalent). The outside compacted fill slopes would consist of material excavated from the pond area and graded to have 2.5H:1V slopes. The perimeter crest would be 30 feet wide for maintenance purposes. The design criteria for the pond would be to contain up to 30 days of drain flow plus runoff from the 6-hour PMP storm event. (The Seepage Collection Pond in Alternative 2 was designed to accommodate the smaller 100-year/24-hour storm.) The capacity of the Seepage Collection Pond shown in Figure 26 is 153 acre-feet (50 million gallons).

A pump station would be located on the west side of the Seepage Collection Pond (Figure 26). The return water pipelines would plumb either into the return water lines in the thickener plant, or into the tailings facility where the water would combine with the tailings water and then would be recovered through the tailings impoundment return water system. The pumps would be rated at 125 percent of the estimated maximum flow into the ponds.

2.5.3.6 LAD Area Modifications

The boundary for the permit and disturbance areas in the LAD Areas 1 and 2 would be modified to avoid old growth and IRAs (Figure 22 and Figure 28). Waste rock would be stored at the impoundment site. LAD Area 1 would be the primary LAD site and would provide 200 acres of land application area (Geomatrix 2007a). LAD Area 2 would be used as necessary and would provide 100 acres of land application area. The timber harvest areas in MMC's proposed LAD Area 2 would be a supplemental LAD Area and would be developed only in the event that supplemental LAD would be necessary to dispose of wastewater (Figure 28). The water balance for Alternative 3 is discussed in more detail in section 2.5.4.3, *Water Use and Management*.

2.5.3.7 Subsidence

Subsidence is the sudden sinking or gradual downward settling of the earth's surface with little or no horizontal motion. Subsidence is a concern because the underground mine would be beneath the CMW. In addition to MMC's proposed underground geotechnical monitoring discussed on page 55, MMC would implement the following measures to reduce the risk of subsidence:

- **Pre-mine Survey**—MMC would install several surface elevation monitoring points over the ore body, working with the lead agencies on the location of these survey sites. The primary focus would be in the initial mining areas or the mining zones closest to the surface. MMC would monitor these sites for movement using conventional surveying at an appropriate accuracy level (0.01 foot). Monitoring would occur prior to mining activities and would occur during and after mining operations or as appropriate based on site-specific geotechnical data. The agencies and MMC could modify the surface monitoring activities based on underground geotechnical data collected by the company during mining operations.
- **Pillar Design**—Using publicly available data (Davidson 1987), the pillar design at the Troy Mine that led to the pillar failure would be back-analyzed to compare the Troy Mine design in effect at the time of the failure with the Montanore design. As pillar designs were refined, numerical modeling would be undertaken to further evaluate expected design performance, including the potential for shear failure at the pillar/roof or pillar/floor interface.
- **Structural Setting**—Improving the understanding of the structural setting, including faulting, jointing, bedding, and the horizontal stress regime would improve the geotechnical design. The description of the Troy Mine pillar design (Davidson 1987) indicates that adverse pillar orientation with regard to bedding dip may have played a role in the pillar collapse, and the Troy Mine sinkhole events appear to be related to faulting. Hydrologic effects could be exacerbated by reactivation of fault zones, such as the Rock Lake Fault or any sympathetic and/or undocumented faulting that may exist. A better understanding of the structural environment at Montanore would benefit the mine design effort and improve the understanding of potential impacts that may arise. These data would be obtained through lineament analysis, mapping and statistical analysis of joint frequency and attitude, strain-relief overcoring, and further exploratory drilling.
- **Interaction of Workings**—MMC has completed some initial numerical modeling to examine the issue of pillar columnization and sill stability between the two ore zones. The modeling would be expanded during final design, as interaction of workings may be crucial to overall pillar/sill stability.
- **Entry Stability and Primary Support**—Roof support analyses would be completed during final design to finalize the support plan and mining span.
- **Final Plan Submittal—**MMC would submit a final mine plan, including final plans for geotechnical monitoring, following completion of the Libby Adit evaluation program to the agencies for approval.

2.5.3.8 Other Modifications

2.5.3.8.1 Reporting

MMC would submit as part of its annual report to the lead agencies a discussion of its compliance with all the monitoring and mitigation requirements specified in the DEQ Operating Permit and the KNF's approved Plan of Operations. Each monitoring and mitigation requirement of the selected alternative would be listed in the report.

2.5.3.8.2 Sound

MMC would operate all surface and mill equipment so that sound levels would not exceed 55 dBA, measured 250 feet from the mill for continuous periods exceeding an hour. Backup beepers may exceed 55 dBA 250 feet from the mill. MMC would adjust intake and exhaust ventilation fans in the Libby Adits so that they generate sounds less than 82 dBA measured 50 feet downwind of the portal. If necessary, specially designed low-noise fan blades or active noise suppression equipment would be used.

2.5.3.8.3 Scenery and Recreation

MMC would design and construct a scenic overlook with information and interpretive signs south of the switchback on NFS road #231 (Libby Creek Road) above Howard Creek with views of the Libby Adit Site. MMC would develop two interpretative signs, one on the mining operation and another one on the mineral resource and geology of the Cabinet Mountains. Parking would be developed in cooperation with the KNF.

MMC would gate certain roads currently open in the mine permit areas during operations (see section 2.5.4.5, *Transportation and Access*). These roads would be different in Alternative 4. The KNF would change the access to other roads for wildlife mitigation (see section 2.5.7.3, *Wildlife Mitigation*). In Alternatives 3 and 4, MMC would check the status of the closure device twice-a-year (spring and fall), and repair any gate or barrier that was allowing access.

MMC would fund a volunteer campground host from Memorial Day through Labor Day at Howard Lake Campground during the construction and operation phases of the mine. MMC would shield or baffle night lighting at all facilities.

2.5.4 Operations Phase

2.5.4.1 Mining

The mine plan would be the same as Alternative 2. If hydrologic modeling during initial mine operations (by Year 5 of operations) determined that one or more bulkheads would be necessary to minimize changes in East Fork Rock Creek and East Fork Bull River streamflows, MMC would submit a plan for bulkheads to the agencies for approval. One or more bulkheads would be maintained underground, if necessary, after the plan's approval.

2.5.4.2 Tailings Management

2.5.4.2.1 Main Dam

The Main Dam would be a compacted cyclone sand dam constructed by the centerline method to an elevation of 3,664 feet (Figure 26 and Figure 27). A crest width of 70 feet was used to account for the upstream slope of the sand deposition and working crest area for the proposed cyclone towers. The downstream slope was set at 2.75H:1V and would be buttressed by a Rock Toe Berm

described above. Based on the height and position of the Rock Toe Berm, the vertical height of the Main Dam would be 230 feet above the Rock Toe Berm crest (Figure 26 and Figure 27). The final crest length would be 10,300 feet, and the main north-south axis would be 5,000 feet long. The left and right abutment sections would be both angled back at about 75 degrees from the main section centerline and tie into the existing ground at the crest elevation (Figure 26). The dam would be raised with cyclone underflow sand hydraulically placed and compacted in cells as described for Alternative 2. The cyclone overflow (fine tailings fraction) would be routed to the tailings thickener plant and combined with the primary thickener underflow and thickened to a 70 percent slurry density.

2.5.4.2.2 Tailings Deposition

For Alternative 3, it is assumed that all tailings deposited into the impoundment would be routed through a thickener plant and deposited as high-density tailings. This would allow a higher average in-place tailings density and stacking of tailings along perimeter areas above the Main Dam crest. Both parameters lead to a reduction in the total impoundment volume required to store conventional tailings slurry.

Tailings slurry would be pumped in buried double-walled HDPE pipelines from the mill at the Libby Plant Site to a thickener facility west of the impoundment. The thickener facility would remove water, or dewater, the tailings to a target slurry density of about 70 percent solids and deposited to achieve an average in-place tailings density of 85 p or greater. Water removed from the tailings would be sent to the water storage pond on the north end of the Poorman Tailings Impoundment (Figure 26).

Tailings Pipelines

Tailings pipelines and reclaim water lines between the impoundment and the mill would be the same design as Alternative 2. In Alternative 3, MMC would bury tailings pipelines in the proposed access road between the Libby Plant Site and the Poorman Impoundment Site. Pipelines would be buried at least 2 feet deep adjacent to the access road. Consequently, the ditch proposed by MMC in Alternative 2 would not be constructed. In addition to the pump station at the Poorman Creek crossing proposed in Alternative 2, another pump station, similar to the Poorman Creek pump station, would be needed at the Ramsey Creek crossing. These pump stations would be outside of the 100-year floodplain to comply with INFS requirements.

Tailings pipelines would be double-walled to reduce the risk of leaks; one type of pipeline used successfully at the Stillwater Mine complex consists of a HDPE pipe inside a steel pipe. The leak detection system proposed by MMC would be used. Burying the pipelines would 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 tailings thickener plant. The pipelines would be visible at the two above-ground crossings of Ramsey and Poorman creeks. Once the pipelines were no longer needed, they would be flushed out into the tailings impoundment. They would be removed from all stream crossings and anywhere they were less than 3 feet below the surface. For other segments of the pipelines, the pipelines would be left in place. They would be cut at 0.5-mile intervals, and capped.

Thickener Facility

It is anticipated that either a high compression thickener or a deep tank thickener system would be required to remove sufficient water for the slurry to create a 70 percent slurry density. A high compression thickener is basically a high rate thickener with higher sidewalls so that a higher

mud level is maintained in the thickener. This produces a higher percent solids underflow, referred to as high-density slurry. The deep tank thickener has a high sidewall so that the aspect ratio of diameter to height is about 1:1. The higher mud level and residence time results in higher percent solids than the high compression thickener. The appropriate selection would be based on a series of rheology tests (test to evaluate the physical relationship between the slurry density and size/material type of the pipe to determine the "pumpability" of the slurry) using representative tailings samples. The number of thickeners would depend on the test results coupled with the production rate. The plant would be expanded in stages to accommodate the increasing tailings production rate over time (from 12,500 to 20,000 tons per day). The water removed from the tailings slurry would be routed to the storage pond in the impoundment and then returned to the mill as make-up water.

The area required for the facility would depend on final design and arrangement of the thickeners. An area up to 300 feet by 200 feet would be located above the impoundment area. The main building and any exterior thickeners/facilities would be painted to help reduce visual impacts. Vegetation surrounding the thickener plant would be retained or planted to help visually blend the plant site with adjacent hillsides. The thickener plant would be designed to receive, dewater, and pump up to 20,000 tons of tailings per day.

Pumping and Deposition

The selection of pumping equipment would depend largely on the type of thickener selected, the pumping pressures required, and rheology of the tailings. Either centrifugal pumps or positive displacement pumps likely would be required for this alternative. The selection would be determined as part of final design studies.

Initially, the high-density slurry would be applied to the ground surface from the crest of the Starter Dam and initial raises of the Main Dam, and retained by a Starter Dam and subsequent Main Dam similar to Alternative 2. Deposition from the dam crest would continue through about Year 5 of operation to establish a back slope for the upstream side of the sand dam and a contact with the tailings slurry. After about Year 5, the thickened tailings would be deposited to the ground from multiple points upslope of the tailings impoundment area to form several mounds of tailings. As tailings deposition continues, the slope of the mounded tailings would overlap and migrate down into the impoundment area. The thickened tailings would form a surface at about a 3 to 5 percent gradient to create a slope of tailings graded down into the impoundment area (Figure 29). The mass of tailings deposited to form the slope would be balanced with the tailings volume within the impoundment area so as not to exceed the height of the Main Dam and provide adequate solution and storm water management capacity within the impoundment area. The last year or two of operation, tailings would be deposited to facilitate final closure of the facility with surface water drainage reporting to the northern corner of the impoundment. Distribution pipelines around the impoundment would be surface mounted for maintenance and operation purposes.

The functionality of Alternative 3 would depend on determination and design of the water removal system (such as deep tank or high compression thickeners) and the strict control of final slurry parameters such as moisture content, deposition sequences, and impoundment water management. During final design, MMC would determine the proper thickener and distribution system and deposition plan for the tailings. MMC would develop an optimum filling plan and operation and monitoring manual that address plant operations, tailings thickening parameter tolerances, contingencies for tailings density not meeting specifications, monitoring of the

thickening process, and reporting to the lead agencies. Similar monitoring and reporting for the tailings impoundment as proposed in Alternative 2 would be implemented for Alternative 3.

2.5.4.3 Water Use and Management

2.5.4.3.1 Project Water Requirements

The water balance in Alternative 3 would have the same components as MMC's projected water balance in Alternative 2. It is based on the same assumptions regarding precipitation and evaporation used in Alternative 2. MMC would maintain a detailed water balance that would be used to monitor water use. Actual volumes for water balance variables (*e.g.*, mine and adit inflows, precipitation and evaporation, and dust suppression) would vary seasonally and annually from the volumes shown in Table 16.

Table 16. Average Process Water Balance, Alternative 3.

Mine-Related Facility	800 GPM Inflow (gpm)	1,200 GPM Inflow (gpm)
Mine and Adit Inflows		
Total estimated inflows	800	1,200
Discharge to LAD Areas with any necessary treatment	307	707
Net inflow to mill	493	493
Mill Inflow		
Net inflow from mine/adit	493	493
Stored water from tailings impoundment	702	702
Make-up water	0	0
Subtotal	1,195	1,195
Mill Outflow		
Water transported with tailings	1,186	1,186
Water in concentrate	9	9
Subtotal	1,195	1,195
Tailings Impoundment Inflow		
Precipitation	427	427
Thickener and cyclone under- and overflows	924	924
Water released from tailings consolidation	282	282
Runoff captured by seepage collection pond	132	132
Runoff captured by tailings impoundment	203	203
Subtotal	1,967	1,967
Tailings Impoundment Outflows		
Dust suppression	60	60
Evaporation	396	396
Water stored in tailings	784	784
Seepage into ground water	25	25
Water recycled to mill	702	702
Subtotal	1,967	1,967

If inflows were less than 450 gpm, make-up water would be needed for the mill. The amount of make-up water required would depend on the configuration of the tailings impoundment, as

precipitation and evaporation at the tailings impoundment are important factors in the water balance. The lead agencies completed an analysis of the make-up water requirements using the Little Cherry Creek Tailings Impoundment as proposed in Alternative 2 and assuming inflows of 450 gpm. Using the Poorman Impoundment Site, 50 gpm make-up water would be required at a steady-state inflow rate of 450 gpm or less. At steady-state flows greater than 500 gpm, make-up water would not be necessary. A water supply well field located north of the Seepage Collection Pond would be used to provide make-up water by drawing from Libby Creek alluvial ground water (Figure 26). Streamflow data indicate this segment of Libby Creek is a gaining reach, likely from ground water flow from glaciofluvial deposits to the west and fractured bedrock aquifers (Geomatrix 2007a). In Alternatives 3 and 4, MMC would not withdraw water for make-up water purposes between August 1 and October 31 if the water source were hydrologically connected to Libby Creek. Potable water needs are expected to be small (11 gpm) and could be withdrawn year-round. As in Alternative 2, MMC would notify the lead agencies if long-term make-up water would be necessary. MMC would modify the aquatic life monitoring plan to take into account such withdrawals. Withdrawals would not proceed until the lead agencies' approval of an updated aquatic life monitoring plan. MMC would need to conduct appropriate pumping tests, and acquire the appropriate water rights from the DNRC during final design.

Maintaining a large pool of water at the toe of "stacked" tailings may affect the feasibility of the depositing high-density tailings slurry above the dam crest in excess of the impoundment capacity created by the dam. In final design, MMC would need to revaluate the water balance and the deposition plan. One option would consider a dam alignment and deposition plan that used the drainage in the northern end of the impoundment area as a dedicated water storage area, at least until the final few years of operation and then infill if needed as part of final deposition and contouring for reclamation. Preliminary evaluation found this may be possible with only minor changes to the Alternative 3 layout and site development. A second option would be to include the Seepage Collection Pond for excess water storage. The operating criteria included in the Alternative 3 water balance estimate had all collected water returned to the system and no accumulated storage in the Seepage Collection Pond.

2.5.4.3.2 Wastewater Discharges

MMC would maintain the current MPDES permit MT0030279 with three outfalls at the Libby Adit Site. Additional discharges would require DEQ authorization. Potential discharges of wastewater associated with Alternative 3 are:

- Seepage or percolation to ground water beneath LAD Areas 1 and 2
- Surface water runoff from LAD Areas 1 and 2
- Seepage or percolation to ground water beneath the Poorman Tailings Impoundment

2.5.4.3.3 Storm Water Control

Sediment and runoff from the tailings facility would be minimized by limiting unreclaimed areas to the active disposal areas. Localized sediment retention structures and BMPs would be used in the downslope perimeter of the impoundment for control, sampling, and recovery of drainage from the tailings thickener 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 thickener facility into storm water ponds. The ditches also would be sized to accommodate a 10-year/24-hour storm event.

Storm water from undisturbed lands above the tailings facility would be diverted around the active portions of the Impoundment Site into Poorman Creek during mine operations. Runoff from reclaimed and fully revegetated, stabilized portions of the tailings thickener 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 thickener facility would be unlined but vegetated, and would drain through a constructed drainage network to existing intermittent drainages. Storm water from reclaimed areas that were not fully stabilized would be captured along with runoff from the active areas of the tailings facility. Undisturbed portions of the facility would either drain into existing drainages or be diverted away from active areas, soil stockpiles, and the storm water pond. All diversions would be sized to handle a 10-year/24-hour storm event. The diversions would be reclaimed and permanent drainageways established when mine operations ended and the site fully reclaimed.

In Alternative 2, MMC proposes to use water and/or chemical stabilization for dust suppression on mine access roads during operations. Mine, adit, or tailings pond water is expected to have elevated suspended soils, nutrients (nitrates), and heavy metals (see section 3.12.2.3.4, *Wastewater Quality*). These compounds could enter surface water if water for dust suppression ran off of the roads. To reduce the potential for adversely affecting water quality in Alternative 3, MMC would use either a chemical stabilization, ground water, or segregated mine or adit water with nitrate concentrations of 1 mg/L or less and with concentrations of all other parameters below the mine drainage ELG, to control dust on mine access roads.

2.5.4.3.4 Water Use and Management

General Water Treatment

MMC proposes in Alternative 2 to use the LAD Areas for primary treatment of excess mine and adit inflows. Currently, MMC has proposed and is permitted by the DEQ under Operating Permit #00150, Minor Revision 06-002, to treat Libby Adit inflows through an existing water treatment plant before discharge to approved Libby Adit Site outfalls. No discharge of Libby Adit water to the LAD Areas is approved as part of Minor Revision 06-002.

The existing Libby Adit Water Treatment Plant would be used if necessary to comply with water quality standards or BHES Order limits to reduce concentrations in adit and mine inflows prior to disposal at the LAD sites. The agencies assumed nitrates would be reduced by 90 percent if pretreatment were necessary before discharge at the LAD Areas. After water treatment, MMC has operational capacity to discharge treated wastewater at the MPDES permitted outfalls at the Libby Adit. As section 3.12.2.3.4, *Wastewater Quality* discusses, MMC expects nitrate concentrations in pumped adit and mine inflows to range from 15 to 25 mg/L. These nitrate concentrations are lower than measured in adit discharges from the Libby Adit when it was initially driven by Noranda between 1989 and 1991. MMC expects lower nitrate concentrations than experienced by Noranda because of its plans to use explosive emulsions and better housekeeping (Geomatrix 2007a). In Alternative 3, in addition to the existing water treatment plant at the Libby Adit, another water treatment system may be necessary at higher wastewater volumes to comply with water quality standards or BHES Order limits prior to disposal at the LAD Areas.

LAD Area Modifications

MMC's proposed access road to LAD Area 1 and the Waste Rock Stockpile in LAD Area 1 would disturb old growth and RHCAs. Old growth and RHCAs are discussed in sections 3.21.2, *Old*

Growth Ecosystems and 3.6.3.12.17, *Riparian Habitat Conservation* Areas, respectively. The boundary for the operating permit and disturbance areas would be adjusted to reflect this modification to avoid those areas (Figure 28). LAD Area 1 would be the primary LAD site and, in combination with the LAD Area 2, would provide about 300 acres where up to 198 gpm of treated water could be discharged through infiltration. Discharges of up to 198 gpm were used for purposes of analysis; discharge volumes may vary and would be based on compliance with water quality standards. Based on the lead agencies' analysis, MMC should have adequate capacity to manage excess water volumes at the existing Libby Adit Water Treatment Plant and outfalls or at the two LAD Areas. If additional capacity were needed, MMC would implement the measures discussed in Alternative 2 to reduce inflows or manage excess water. Stormwater runoff from the LAD Areas would be captured in a lined stormwater retention pond, and discharged to Poorman Creek via a constructed channel designed to minimize erosion.

2.5.4.4 Solid Waste Management

MMC's proposal in Alternative 2 to store buried sewage tanks adjacent to the mill/office building and then disposed off-site would be modified in Alternatives 3 and 4. MMC would submit plans and specifications for public water supply wells, as well as plans for construction of a sanitary waste treatment facility to the DEQ for approval. MMC would treat all sanitary wastes to the degree necessary to meet MPDES effluent limits. After treatment, sanitary wastes would be either recycled to the mill for process water, or discharged as wastewater to the LAD Areas.

In Alternative 2, MMC would occasionally bury certain wastes underground in mined-out areas. In Alternative 3, MMC would minimize the amount of wastes underground or at the tailings impoundment. All wastes proposed for disposal underground or at the tailings impoundment would be identified during operations and at closure, and reviewed and approved by the agencies prior to disposal.

2.5.4.5 Transportation and Access

2.5.4.5.1 Road Management Plan

INFS standard RF-2 requires the development and implementation of a Road Management Plan. In Alternatives 3 and 4, MMC would develop for the lead agencies' approval, and implement a final Road Management Plan that would describe for all new and reconstructed roads used for the mine and transmission line the following:

- Criteria that govern road operation, maintenance, and management
- Requirements for pre-, during-, and post-storm inspections and maintenance
- Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives
- Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control
- Mitigation plans for road failures

The plan would incorporate safety signing such as "Caution Truck Traffic" signs at several locations between U.S. 2 and the Libby Plant Site on both Libby Creek and Bear Creek roads. Other appropriate wording could be used as approved in the Road Management Plan. The plan would describe management of road surface materials during plowing, such as snow and ice.

Sidecasting of soils or snow would be avoided. Sidecasting of road material would be prohibited on road segments within or abutting RHCAs in priority watersheds.

2.5.4.5.2 Bear Creek Road (NFS Road #278) and Libby Creek Road (NFS Road #231)

The following sections describe road use and public access along the main access road (Bear Creek Road (NFS road #278), Libby Creek Road (NFS road #231), and each proposed permit area. With the exception of the Bear Creek Road, all open roads in the impoundment permit area would be gated and limited to mine traffic only. Non-motorized public access would be restricted within each permit area by signage at the permit area boundary. Table 17 lists those roads with a change in road status in Alternative 3; these roads are shown on Figure 30.

As discussed previously, the agencies incorporated the Libby Adit evaluation program into Alternatives 3 and 4. MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. MMC would install a gate on the Libby Creek Road and maintain the gate and the KNF would seasonally restrict access on the two roads as long as MMC uses and snowplows the two roads. Culverts along all access roads that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows. Any work in a RHCA along an access road would be completed in compliance with INFS standards and guidelines.

In Alternative 3, MMC would use the Bear Creek Road as in Alternative 2 for main access during operations (Figure 2). About 13 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Poorman Tailings Impoundment Site, would be paved and upgraded to a roadway width of 26 feet. Additional widening would be necessary on curves. The disturbed area, included ditches and cut-and-fill slopes, is expected to be up to 100 feet wide. The existing Bear Creek bridge, which currently is 14 feet wide, also would be replaced and widened to a width compatible with a 26-foot wide Bear Creek Road. During upgrading of the Bear Creek Road, MMC would use the Libby Creek Road. A travel lane on the Bear Creek Road would be maintained to allow continued motorized public access. During operations, MMC would use a supply staging area in Libby where shipments to the mine site would be consolidated.

South of Little Cherry Creek, MMC would build 3.2 miles of new road west of Bear Creek Road that would connect Bear Creek Road with Ramsey Creek Road (NFS road #4781) (Figure 30). The new road would be designated NFS road #278 (the new Bear Creek Road) and would generally follow the 3,800-foot contour to north of the Poorman Creek bridge. To maintain a public access connection between the Bear Creek Road and the Libby Creek Road (NFS road #231), the public would use the new Bear Creek Road, a segment of the Poorman Creek Road (NFS road #2317), and a segment of the Bear Creek Road south of Poorman Creek. The crossing of the new Bear Creek Road across Poorman Creek would be built to accommodate the 100-year flow event and be constructed in compliance with INFS standards. It would either be a bridge or arched culvert. The crossing width would be consistent with the roadway width.

The newly-abandoned Bear Creek Road (NFS road #278) between the Libby Plant Access Road and just north of Poorman Creek and on a segment of the Little Cherry Loop Road (NFS road #6212) would be gated during operations and used exclusively for mine traffic and public access would be eliminated (Figure 30). The gates on the Little Cherry Loop Road (NFS road #6212) would be near the tailings impoundment permit area boundary on the north end and near its intersection with the Bear Creek Road south of Poorman Creek on the south end.

Table 17. Proposed Change in Road Status during Operations, Alternative 3.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
2317B	Poorman Creek B	LAD Area 2	No closure order, impassable	0.8	Gated, mine traffic only
278X	Bear Creek X	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.0	Gated, mine traffic only
4781	Ramsey Creek	LAD Area 2	Open	0.3	Barriered year-long to motor vehicles
4781	Ramsey Creek	LAD Area 1 up Ramsey Creek	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	3.2	Barriered year-long to motor vehicles
5170	Poorman Creek Unit	LAD Area 2	Open	0.2	Gated, mine traffic only
5186	Ramsey Creek Bottom	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Gated, mine traffic only
14403	Lower Ramsey	Libby Plant Site	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Gated, mine traffic only
6201	Cherry Ridge	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.3	Gated, mine traffic only
6201A	Cherry Ridge A	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.9	Gated, mine traffic only
6212	Little Cherry Loop	Tailings Impoundment	Open	2.1	Gated, mine traffic only
6212L	Little Cherry Loop L	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.5	Gated, mine traffic only
6701	South Ramsey Creek	Upper Ramsey Creek	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Barriered year-long to motor vehicles

MMC would surface the existing Bear Creek Road (NFS road #278) from just south of Poorman Creek to the Libby Creek Road (NFS road #231) with 6 inches of gravel 16 feet wide (Figure 30). This surfacing would ensure the safe transition from the improved section north of the new Libby Plant Access Road and the unimproved section to the Libby Creek Road.

Similar to Alternative 2, MMC would use open and closed roads in Alternative 3. Some currently open roads would be gated. As part of the lead agencies' mitigation, MMC would be responsible for installing and maintaining gates at each closure. The gates would have dual-locking devices to allow the KNF fire or administrative access. When accessing areas regulated by the Mine Safety and Health Administration, KNF personnel would check in at the mine office before entering regulated areas.

2.5.4.5.3 Poorman Tailings Impoundment Area

The roads used to haul waste rock from the Libby Adit and the Upper Libby Adit to the Poorman Tailings Impoundment Area are shown on Figure 30. Except of a segment of the Upper Libby Creek Road (NFS road #2316) and the Poorman Creek Road (NFS road #2317) in LAD Area 2, mine haul roads would be restricted to mine traffic only. Because of the joint use on these two roads (Figure 30), they would be widened to accommodate haul truck traffic and another lane of public traffic. The joint-use road segments would be widened to widths recommended by the Mine Safety and Health Administration (Mine Safety and Health Administration 1999). For a 16-foot wide haul vehicle, the road width would be 56 feet wide to accommodate joint-use traffic safely. MMC would use a segment of the existing Bear Creek Road north of LAD Area 2 for mine haul.

The crossing of the old Bear Creek Road across Poorman Creek would be built to accommodate the 100-year flow event and be constructed in compliance with INFS standards. It would either be a bridge or arched culvert. The crossing width would be consistent with the roadway width.

Besides Bear Creek Road, Little Cherry Loop Road (NFS road #6212) is the only other road within the Poorman Tailings Impoundment area that is open to public, motorized access. MMC would close Little Cherry Loop Road within the proposed permit area boundary to public access and would use it during the construction, operation, and closure of the Poorman Tailings Impoundment. NFS road #6212 would remain open north of the proposed permit area boundary to the junction with Bear Creek Road. The following closed National Forest System roads within the impoundment area would be used in Alternative 3: #1408 to the private land in the NW¼, Section 25, Township 28 North, Range 31 West, #5181, #5181A, #5185, #5185A, #5187, #6212H, #6212L, #6212M, and #6212P (Figure 30).

2.5.4.5.4 LAD Areas 1 and 2

No open roads are within the proposed permit area for LAD Area 1. A short segment of the Poorman Creek Road (open NFS road #2317) is near the northern boundary of the LAD Area 1 permit area. In Alternative 3, the currently open segment of the Poorman Creek Road would remain open and be used to access LAD Area 1. MMC would develop a small unpaved recreational parking area near the intersection of the Libby Plant access road and Poorman Creek Road (Figure 28). A parking area would facilitate non-motorized access to the Poorman Creek drainage via the Poorman Creek Road. MMC also would develop a new hiking trail between Poorman and Ramsey creeks to provide non-motorized access to upper Ramsey Creek.

A short segment of the Ramsey Creek Road (NFS road #4781) on the eastern and southern boundaries of the LAD Area 1 is open. MMC would close this segment to public access and use it for mine haul traffic. MMC also would use the closed NFS road #2317B for access within LAD Area 1. As in Alternative 2, two currently barriered roads (NFS road #278X and #5186, and 0.2 mile of open NFS road #5170 would be gated and used for mine traffic only (Figure 30).

2.5.4.5.5 Libby Plant Site, Libby Adit and Upper Libby Adit

MMC would use the same roads (NFS road #4781, NFS road #6210 between Ramsey Creek and Libby Creek, and NFS road #2316) for access to the Libby Adit Site and Libby Plant Site (Figure 30). Modifications to these roads also would be the same as Alternative 2, except for a segment of NFS road #2316 west of NFS road #6210. A segment of NFS road #2316 west of the Libby Adit Site would provide access to the Upper Libby Adit Site. Because NFS road #2316 is currently open to the public, it would be widened to 56 feet accommodate joint public/mine haul traffic.

A new bridge across Ramsey Creek would be needed. The bridge would accommodate the 100-year flow event and be constructed in compliance with INFS standards. Bridge width would be compatible with the roadway width. A short segment of closed NFS road #14403 would provide access to the Libby Plant soil stockpile.

2.5.4.5.6 Ramsey Creek Drainage

Access and road use on NFS road #4781 up Ramsey Creek and NFS road #6701 would change from gated to barriered to provide grizzly bear mitigation.

2.5.5 Reclamation Phase

Short- and long-term reclamation objectives would remain the same as for Alternative 2. These objectives would be achieved through interim and final reclamation of all disturbed sites as described for Alternative 2, with additional mitigation described below and implementing all erosion- and sediment-control measures described for Alternative 2.

2.5.5.1 Post-Mining Topography of Project Facilities

The post-mining topography of project facilities would follow the procedures outlined for Alternative 2 with the following modifications. MMC would develop final regrading plans for each facility to reduce visual impacts of reclaimed mine facilities. These plans would require the agencies' approval prior to implementation. At the end of operations, any waste rock not used in construction would be either placed back underground or used in regrading the tailings impoundment. Waste rock used at the Libby Plant Site could require an MPDES permit modification to include runoff or seepage from the waste rock.

MMC would develop plans to shape slopes of the Libby Plant Site (Figure 31), mine portal areas, and Libby Adit Site to closely resemble the surrounding landscape. Final grading would involve regrading and shaping flat surfaces to blend with the adjacent landscape and have natural dendritic drainages. Additional fill would be used as necessary to create smooth transitions between human-made and natural landforms.

2.5.5.1.1 Poorman Tailings Impoundment

Deposition of the tailings at closure would produce a final surface as shown in Figure 32. As part of reclamation, all surface facilities would be removed from the site. Inert materials may be buried within the tailings facility prior to placement of final cover. MMC would provide a list of

material and items to be buried and a cover plan for burial to the lead agencies for approval prior to burial of the items and materials. Once all water had been removed (evaporated, treated, and discharged) from the tailings surface in the northern area, and the near surface tailings have stabilized for equipment access, a channel would be excavated through the tailings and Saddle Dam abutment to route runoff from the site toward a tributary of Little Cherry Creek. The channel would be routed at no greater than 1 percent slope and along an alignment requiring the shallowest depth of tailings to be excavated down to the channel grade. The side slopes would be designed to a stable slope and covered with coarse rock to prevent erosion. The channel section through the abutment would be backfilled with a porous dam section designed to retain the PMF and dissipate the flood water at a flow rate of 2 cfs or within a 60-day period, whichever flow rate is the greater. This design would allow discharge runoff from the site and minimize channel stabilization in the drainage above Little Cherry Creek and water quality impacts to the receiving waters in Little Cherry Creek.

The tailings surface and disturbed areas would be covered as outlined Alternative 2. MMC would survey tailings settlement at closure on a 100-foot by 100-foot grid to document settlement. The area would be surveyed after borrow material used for fill was placed to create final reclamation gradients, and again after soil placement to ensure runoff gradients were achieved and soil thicknesses were met. Rocky borrow and geotextile be needed for construction equipment to work on the tailings surface. In Alternative 2, MMC would place riprap on the dam crest and uppermost part of the dam face to minimize potential gully formation at the tailings dam crest. In Alternative 3, MMC would use rocky borrow from within the disturbance area to provide erosion protection. Borrow material volumes would be determined during final design.

Post-operational seepage management would be the same as Alternative 2. MMC would operate the seepage collection and the pumpback well systems until water quality standards or BHES Order limits were met without additional treatment. Long-term treatment may be required if water quality standards were not met. The length of time these closure activities would occur is not known, but may be decades or more. Following removal of the Seepage Collection Dam, the disturbed area would be graded to blend with the original slope. After water quality standards or BHES Order limits were met, seepage from the underdrains and seepage not intercepted by the underdrains would flow to Libby Creek.

MMC would develop a design to recontour faces of the tailings impoundment dams to more closely blend with the surrounding landscape than proposed in Alternative 2. Sand deposition would be varied during final cycloning and placement of sand on the dams. This design would incorporate additional rocky borrow at selected locations on the dam face and use benches in some locations. Islands of trees and shrubs would be planted in the rocky areas. The seed mixture on the dam face would vary to reduce uniformity of the revegetated dam.

2.5.5.1.2 Roads

Reclamation of the Bear Creek Road, new roads, currently open roads, and all new bridges used in Alternative 3 would be the same as Alternative 2. The existing Bear Creek Road and the new Bear Creek Road from the Poorman Tailings Impoundment Site to south of Poorman Creek would remain chip-sealed and 26 feet wide. All currently gated or barriered roads used in Alternative 3 would be decommissioned by using a variety of treatment methods to achieve desired conditions for other resources. The existing culvert across Poorman Creek on the former Bear Creek Road (NFS road #278) and the existing bridge across Poorman Creek on the Little Cherry Loop Road (NFS road #6212) would be removed at closure and the area revegetated.

2.5.5.2 Revegetation

2.5.5.2.1 Revegetation Success/Bond Release Criteria

The following criteria for all reclaimed areas, including the transmission line right-of-way and access roads, would be used to determine revegetation success and bond release. Minimum vegetation cover would be 80 percent of the control site total cover. If the required minimum cover were not obtained, MMC would implement remedial action such as reseeding with a modified seed mixture, mulching, fertilizer, or other changes to address the issue. If after two remedial attempts the particular site still did not meet the minimum vegetative cover standard but met 80 percent of the average of selected control sites, did not exhibit rills or gullies, and met the weed standard, it would be released. If the site continued to fall short of meeting the cover requirement, a third remedial effort, approved by the lead agencies, would be applied. If the standard still were not met but the site had 70 percent of the control cover and did not exhibit rills and gullies and met the weed standard, it would be released.

MMC and the lead agencies would establish control sites for the project prior to operation activities. These sites should be similar to the reclaimed areas and be in close proximity to the mine area. MMC would develop a vegetation monitoring program from these sites and collect vegetation data during the mine life. This information would be used to validate the release criteria numbers with respect to minimum cover requirements, tree/shrub density, weeds, and other provisions preliminarily set during the EIS. The intent is to provide long-term site-specific data to support the release criteria established for the project. The monitoring plan would be approved by the lead agencies and would require the report be submitted annually or as outlined in the plan or as approved by the lead agencies. Monitoring would continue for 20 years after planting or seeding to ensure revegetation requirements have been met, or less if the project bond were released by the lead agencies before this period expired.

Noxious weeds would have less than 10 percent cover of species listed as Category 1 (existing infestations) and 0 percent cover of Category 2 and 3 (new invaders and potential invaders, as described in the KNF Noxious Weed Handbook, Spring 2008, Edition 5.0) in reclaimed areas. Data collected by MMC on control sites would be used to update/validate these values based on site-specific data. Noxious weeds would not dominate in any area greater than 400 square feet. No bare areas greater than 200 square feet would be allowed in reclaimed areas.

A minimum of 400 trees and 200 shrubs per acre would be living after 15 years (density would be lower in some areas where no trees or shrubs would be planted such as herbaceous wetlands and meadows).

2.5.5.2.2 Seed Mixture Modifications

MMC would revise all seed mixes so that mixes would be composed of species native to northwestern Montana. MMC would select seed mixes to be compatible with dry and moist forest conditions. On dry south-facing slopes, a seed mix with more aggressive plant species able to establish under harsh conditions would be used, while in moist areas, the aggressive species would be avoided. Native seed mixes would have the ability to be updated in conjunction with ongoing research and as more information becomes available, or as directed by the lead agencies. MMC would include introduced species only with prior approval from the lead agencies.

The interim and permanent seed mixes proposed for Alternative 2 contain introduced species (Table 18). In the proposed seed mixes, MMC would not use the species shown in Table 18, and

would replace them with native species, to the extent native species were commercially available. MMC would assess which native species were available commercially, and submit final permanent seed mixes to the lead agencies for approval. In the event native species were not establishing rapidly enough to control invasive plants, MMC would submit an alternative seed mixture to the lead agencies for approval. The alternative mixture could include non-native species that would meet the overall goals and objectives of the reclamation plan. MMC would conduct seeding between August 15 and October 31, or between April 1 and June 15. All areas would be seeded with the permanent seed mix; the interim seed mix proposed in Alternative 2 would not be used. Change in the seeding schedule would be approved by the lead agencies.

Table 18. Introduced Species Eliminated from MMC's Proposed Seed Mixes.

Revegetation Mixture 1	Revegetation Mixture 2
Redtop (*Agrostis gigantea*)	Redtop (*Agrostis gigantea*)
Meadow foxtail (*Alopecurus pratensis*)	Orchardgrass (*Dactylis glomerata*)
Tall fescue (*Festuca arundinacea*)	Canada bluegrass (*Poa compressa*)
Timothy (*Phleum pratense*)	White clover (*Trifolium repens*)
White clover (*Trifolium repens*)	

2.5.5.2.3 Planting

MMC cites recommendations for establishment of seedlings (not planting) ranging from 400 to 680 trees per acre, but plans 435 trees per acre and 200 shrubs per acre. At a success rate of 65 percent, this would yield 283 trees and 130 shrubs per acre, which would be at the low end of the densities recommended by KNF. In Alternative 3, MMC would plant sufficient trees and shrubs to achieve 400 trees and 200 shrubs per acre 15 years after planting.

To help prevent noxious weed establishment, MMC would plant trees and shrubs randomly by hand unless safety issues require machine planting. MMC would mulch around planted trees and shrubs, and control weeds adjacent to trees and shrubs, but apply native seed elsewhere. If noxious weeds colonized planting areas, and weed control with herbicides were necessary, trees would likely be lost. MMC would use an agencies-approved wood-based compost to promote fungi-based communities and tree growth rather than straw or manure based compost that promotes bacteria-based grassland communities.

2.5.5.2.4 Organic Amendments

MMC would amend the top 0 to 4 inches of soil before seeding with an agencies-approved wood-based organic amendment to raise the organic matter level in the soil to a minimum of 1 percent by volume.

2.5.5.2.5 Noxious Weed Mitigation Measures

MMC has a Weed Control Plan approved by Lincoln County Weed Control District. The plan would be modified as described in this section and submitted to the lead agencies during final design for their approval. Following KNF's and DEQ's approval of the final Weed Control Plan, MMC would submit it to the Lincoln County Weed Control District. These measures would be applied to all permit areas, and all currently unopened roads used for transmission line access.

MMC would submit an annual report to the lead agencies describing weed control efforts. The report would provide a map showing areas of weed infestation that were treated in the preceding year. It also would provide a qualitative evaluation of the weed control efforts.

MMC would implement all weed BMPs identified in Appendix A of the KNF Invasive Plant Management Final EIS (KNF 2007a) for all weed-control measures. MMC would focus mitigation on prevention as the most effective and least expensive weed management strategy, and early detection and eradication as the best alternative once a new species had been introduced. For established invaders, treatment and containment of noxious weeds species would be the main objective. MMC would include integrated noxious weed management in the environmental training program.

MMC would comply with state and local laws and agencies' guidelines for all noxious weed-control activities. All herbicides used in the project area would be approved for use in the KNF, and would be applied according to the labeled rates and recommendations to ensure the protection of surface water, ecological integrity, and public health and safety. Herbicide selection and application timing would be based on target species on the site, site factors (such as soil types and distance to water), and with the objective to minimize impacts to non-target species. MMC would coordinate with the KNF Weed Specialist for use of biocontrol agents as they become available.

To the extent possible, MMC would survey all proposed ground disturbance areas for noxious weeds prior to initiating disturbance. Where noxious weeds were found, MMC would treat infestation the season before the activity was planned. For example, if timber clearing were planned to being in the spring, the survey and control would be implemented the previous fall. Areas surveyed would include roads, borrow areas, tailings impoundment, transmission line, LAD Areas, and any other areas designated for timber removal. MMC would describe in final design plans the extent of which surveys and pretreatment would not be feasible. The proposed survey and treatment approach would be a part of the final Weed Control Plan, to be reviewed and approved by the lead agencies.

MMC would include road-related weed mitigation in any road access that was approved for the project (including access routes to the transmission line). MMC would treat noxious weeds along all haul and access roads yearly with the appropriate herbicide mix for the target species. MMC would broadcast treat every other year and spot treat the alternate years.

MMC would minimize soil disturbance and mineral soil exposure during ground-disturbing activities. Ground disturbance should be no more than needed to meet project objectives. MMC would prevent road maintenance machinery from blading or brushing through known populations of new invading noxious weed species. In areas where noxious weeds were established and activities require blading, MMC would brush and blade areas with uninfested segments of road systems to areas with noxious-weed infested areas. MMC would limit brushing and mowing to the minimum distance and height necessary to meet safety objectives in areas of heavy weed infestations.

MMC would pressure wash all off-road equipment including equipment for mining, vegetation clearing, road construction and maintenance, and reclamation before entering the project area to help prevent the introduction of new invader noxious weed species to the area.

MMC would continue to monitor/survey the project area for new invader weed species on a yearly basis. MMC would monitor weed population levels with particular emphasis on haul

routes, access routes, borrow areas, soil stockpiles, and the transmission line corridor. MMC would treat weed infestations as needed.

In areas where timber was to be removed (particularly the transmission line corridor), MMC would consider winter vegetation clearing to reduce mineral soil exposure and the chance of spreading existing noxious weeds.

MMC would implement site-specific guidelines to be followed for weed treatments within or adjacent to known sensitive plant populations. MMC would evaluate all future treatment sites for sensitive plant habitat suitability; suitable habitats would be surveyed as necessary prior to treatment.

2.5.6 Operational and Post-Operational Monitoring Programs

Numerous operational and post-operational monitoring programs proposed by MMC are described in Alternative 2. Except as described in the following sections, these programs in Alternative 3 would be the same as Alternative 2. For example, in Alternative 3, MMC would complete a ground water-dependent ecosystem inventory of an area overlying the proposed underground mine. MMC did not propose such an inventory in Alternative 2. The proposed inventory is described below, and is incorporated by reference into Alternative 4. The air quality monitoring program would be the same in Alternative 2 as Alternatives 3 and 4. Therefore, the air quality monitoring program is not discussed in Alternatives 3 or 4.

2.5.6.1 Ground Water Dependent Ecosystem Inventory

2.5.6.1.1 Inventory Objectives

The intent of the monitoring program is to provide long-term monitoring of the water resources and ground water-dependent ecosystems that could be impacted by the mine. Prior to the Libby Adit evaluation program, MMC would complete a comprehensive ground water-dependent ecosystem (GDE) inventory (springs, wetlands, fens, flora, fauna, hyporheic zones, gaining reaches of streams) focusing on areas below about 5,600 feet. The inventory area is shown on Figure 33. A GDE inventory would be needed because a comprehensive inventory of the resources overlying the proposed mine facilities has not been completed. An inventory would help identify and rank GDEs based on their importance in sustaining critical habitats or species and the most important or vulnerable ones would be targeted for monitoring. The inventory would be conducted in accordance with the most current version of the Forest Service's *Ground-Water Resource Inventory and Monitoring Protocol* (USDA Forest Service 2006a).

2.5.6.1.2 Springs Inventory

The inventory area is shown on Figure 33 would be surveyed for springs. In this initial inventory, the flow of spring would be measured twice, once in early June or when the area was initially accessible, and once between mid-August and mid-September. The most accurate site-specific method for measuring spring flow would be used, which may include the use of a flume, weir, flow meter or timed volumetric measurement. Any spring with a measurable flow between mid-August and mid-September would be assessed for its connection to a regional ground water system, based on flow characteristics (*e.g.*, possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation), water chemistry, and the hydrogeologic setting (*e.g.*, associated geology such as the occurrence or absence of colluvium or alluvium).

2.5.6.1.3 Wetland and Riparian Vegetation Inventory

The inventory area, shown on Figure 33, would be surveyed for ground water-dependent wetlands, fens, and riparian areas. At each critical GDE habitat identified from the inventory, a vegetation survey would be completed. A botanist/plant ecologist or other qualified individual would design survey methodology and protocols that would be approved by the agencies. Initial survey data would include site photos and points, GPS site locations, basic site descriptors, and plant species composition, focusing on hydrophytes (plants that are able to live either in water itself or in very moist soils).

2.5.6.1.4 Stream Base Flow Inventory

In the initial inventory, the flow of any stream in the GDE inventory area would be measured when the area was initially accessible, monthly during the summer months and weekly between mid-August and mid-September. The most accurate site-specific method for measuring streamflow would be used, which may include the use of a flume, weir, flow meter, or timed volumetric measurement. Any stream with a measurable flow between mid-August and mid-September would be assessed for its connection to a regional ground water system, based on the associated hydrogeology such as faults or the occurrence or absence of colluvium and/or alluvium and possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation. Gaining stream reaches would be mapped, and then monitoring locations would be refined to focus on gaining reach lengths and flow.

2.5.6.1.5 Lakes Inventory

Beginning 1 year prior to construction, the levels of Rock Lake, St. Paul Lake, and Lower Libby Lake, which all overlie the proposed mine, would be measured continuously. Each lake would be assessed for its connection to a regional ground water system, based on water balance, the associated hydrogeologic characteristics such as faults or the occurrence or absence of colluvium and/or alluvium and possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation.

2.5.6.2 Ground Water Dependent Ecosystem Monitoring

2.5.6.2.1 Monitoring Objectives

GDE monitoring would have locations and frequency specified based on inventory data and on the local hydrogeology and proximity to the mine or adit void. The objective of GDE monitoring would be to detect changes in ecological integrity of dependent species and habitat. A GDE Monitoring and Mitigation Plan would be developed for important GDEs found during the inventory that would most effectively detect and minimize stress to flora and fauna from surface effects of mine dewatering. The plan would be submitted to the agencies for approval after the GDE inventory is completed and early enough for 1 year of baseline data to be collected before mining begins. The plan would include piezometers in critical locations. The plan would include a monitoring schedule, a mitigation plan, and mitigation implementation triggers. The results of the initial inventory, subsequent inventories, and monitoring would be reported in annual reports to the lead agencies.

There are several criteria required to decide which characteristics to monitor, including traits that: (1) *have a defined relationship with groundwater levels*; there needs to be confidence that a measured response within a parameter reflects altered ground water levels rather than other abiotic/biotic factors; (2) *are logistically practical*; parameters should be practical to measure

within the constraints of a wilderness setting; parameters that reflect landscape responses by GDEs of wide distribution, such as remote sensing of hydrophytic vegetation health, could be considered; (4) *have early warning capabilities*; it is important to consider the 'lag' time between changed ground water levels and environmental condition and/or health. The response of vegetation parameters influenced by changed ground water levels can take a long time to manifest and further reductions may occur before impacts of previous changes are realized; consequently, parameters with rapid responses are favored (*e.g.*, piezometers), as they provide advanced warning of significant stress or degradation on the system, as well as providing the opportunity to determine whether intervention or further investigation is required. Nevertheless, some GDE values may have to be measured through parameters with a greater 'lag' time (*e.g.*, hydrophytic vegetation community composition).

Table 19 identifies the specific monitoring options for surface resources in the area. After the initial survey, the options in the table will help establish the methods that would be used to monitor GDEs.

Table 19. Ground Water Dependent Ecosystem Inventory and Monitoring, Alternatives 3 and 4.

Surface Resource Component	Look For:	Using:
Springs, Lakes, and Streams	Flow changes	Flow monitoring
	Lake level changes	Continuous level recorder
	Ground water level changes	Piezometers
Wetland and Riparian Vegetation	Ground water level changes	Piezometers
	Dieback, early desiccation, habitat decline	Photo points, field surveys, remote sensing
	Soil moisture stress	Tensiometers
	Plant water potential/turgor pressure changes	Pressure bomb technique
Amphibians, Mollusks, Macroinvertebrates, Fish	Population decline, community composition change	Field surveys
Terrestrial Animals	Population/usage decline	Field surveys

2.5.6.2.2 Springs Monitoring

The flow in springs determined to be supported by the regional ground water system or whose connection to the regional ground water system was uncertain would be measured annually between mid-August and mid-September. A spring that was determined, after repeated flow measurements, not to be connected to the regional ground water system may be eliminated from additional monitoring. However, additional monitoring of flow and quality of any spring overlying the proposed mine may be required, depending on the outcome of the GDE inventory. Flow monitoring of springs or streams, by itself, is generally inadequate because mining induced impacts are frequently subtle and hard to distinguish from natural variability. Flow monitoring can only detect relatively large mining induced changes in flow.

2.5.6.2.3 Wetland and Riparian Vegetation Monitoring

Indicator hydrophytes and their distribution and frequency would be chosen from the initial survey information and identified as "trigger plants." Trigger plants would serve as a basic

"trigger" to begin annual monitoring in a particular site. Other monitoring options such as piezometers would be used to facilitate or strengthen monitoring effectiveness. If a change in seep or spring flow, water level, or water quality were noted outside the baseline data for an individual site or set of sites, a re-evaluation of those potentially affected habitats would be conducted and documented for comparison against initial survey information. Depending on a combination of biological or physical variables or the severity of plant indicator decline, the lead agencies may require more rigorous monitoring. Potential monitoring options for wetlands (including fens) and riparian areas are shown in Table 19.

2.5.6.3 Surface and Ground Water

The lead agencies' modified MMC's proposed surface and ground water monitoring plan. The plan is presented in Appendix C.

2.5.6.4 Fisheries and Aquatic Life

The lead agencies' modified MMC's proposed fisheries and aquatic life monitoring plan. The plan is presented in Appendix C.

2.5.7 Mitigation Plans

In Alternative 3, the wetlands, fisheries, and wildlife mitigation plans would differ from that proposed in Alternative 2. The proposed plans for these resources are discussed below. The Hard Rock Mining Impact Plan would be the same as Alternative 2.

2.5.7.1 Wetland Mitigation

2.5.7.1.1 Proposed Sites

In Alternative 2, MMC proposed to mitigate affected forested and herbaceous wetlands at a 2:1 ratio, and herbaceous/shrub wetlands and waters of the U.S. at a 1:1 ratio. MMC's proposed mitigation sites are two sites in the Little Cherry Creek drainage, three sites between Little Cherry and Poorman creeks (in Alternative 3, the Poorman Impoundment Site), one site east of LAD Area 1, and one site at the Libby Creek Recreational Gold Panning Area (Figure 21). In Alternative 3, the three sites between Little Cherry and Poorman creeks and one of the sites at Little Cherry Creek would not be available because they would be within the Poorman Tailings Impoundment Site. MMC's proposed mitigation site at the Libby Creek Recreational Gold Panning Area was not part of Noranda's 1993 Section 404 permit. Because of high public use of the Recreational Gold Panning Area, it would not be used in Alternative 3 or 4.

In Alternative 3, possible wetland mitigation sites would include 2.2 acres at the Little Cherry Creek site, 15.3 acres at the South Little Cherry Creek sites, and 6.7 acres at the Ramsey Creek site (Figure 34). The Corps would be responsible for developing final mitigation ratios for jurisdictional wetlands, depending on the function and values of the affected wetlands. The minimum ratio for wetland restoration (reestablishment and rehabilitation) is 1.5 acres restored to 1 acre impacted; the minimum ratio for establishment is 2 acres established to 1 acre impacted (Corps 2005). Sufficient mitigation sites have been identified to achieve the Corps' minimum ratios. In addition to mitigation for jurisdictional wetlands, MMC would mitigate for non-jurisdictional wetlands at a ratio of 1 acre mitigated to 1 acre impacted. The amount of jurisdictional and non-jurisdictional wetlands affected by the mine alternatives are listed in Table 149.

Wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. Before final design, shallow piezometers or monitoring wells would be installed in the proposed mitigation sites and 6 months of monthly monitoring (April through September) of water levels to determine ground water levels would be completed. Monitoring data would be submitted with the final wetland mitigation plan. The shallow wells would be used to assess whether ground water would support wetlands if the mitigation sites were excavated to near the ground water surface. Ground water from beneath the tailings impoundment would not be used to provide hydrologic support as proposed in Alternative 2. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas.

According to MMC, the Ramsey Creek mitigation site is part of an existing man-made wetland area. The site would be expanded by spreading out streamflow that would provide hydrologic support. MMC would conduct a wetland delineation of the proposed area during final design to ensure the wetland was jurisdictional. The site would be used to mitigate either jurisdictional or non-jurisdictional wetlands, depending on the jurisdictional status of the existing wetland.

2.5.7.1.2 Monitoring of Wetland Mitigation Sites

Monitoring of wetland mitigation sites would be conducted annually, generally as proposed in Alternative 2, with the following changes. The monitoring described in this section may be modified in a Corps' 404 permit, if issued for the project. If success were not achieved within 5 years, MMC would be required to modify the sites or implement other mitigation plans, both of which would subject to approval by the Corps. Wetland monitoring requirements would be extended if success were not achieved within the 5-year period.

Vegetation data would be collected at established quadrat sampling points along established transects to determine vegetation composition. Transects would be spaced at 100-foot intervals along the length of each wetland mitigation site or adjusted to ensure that each mitigation site is adequately sampled to support wetland determinations that proposed acreage is achieved. There would be a minimum of three sampling stations per transect with 1 quadrat sampling point for herbaceous cover type nested within one 10-foot radius sample plot for woody cover type per sampling station. Vegetation assessments would be accomplished in accordance with Corps-accepted sampling techniques. Photo documentation points would be established for each wetland site. Reports would contain a minimum of two photos per site taken during the growing season.

Hydrology data from shallow ground water wells in each mitigation site would be collected at the normal peak of the hydrograph and/or ground water and in September. Frequency and duration of adequate hydrology would be documented in the monitoring reports. Soils also would be investigated for evidence of hydrologic saturation, such soil color, texture, and mottling.

Wetland mitigation success would be achieved when the mitigation site had more than 60 percent gross vegetative aerial coverage as determined by the average of all quadrat sample plot data. Hydrophytes must comprise a minimum of 90 percent of the dominant species as determined from the average of all data points from all polygons. All wetland data points would be comprised of more than 50 percent hydrophytes that were Montana native species. A weed control plan would be implemented for any site if noxious weed species comprised more than 20 percent of the dominants at any mitigation site.

2.5.7.2 Fisheries Mitigation

2.5.7.2.1 Access Road Use

For the Libby Adit evaluation program, MMC would implement the BMPs shown in Table 20, such as installing, replacing, or upgrading culverts, to bring the proposed access roads (NFS roads #231 and #2316) up to INFS standards. All ditches on NFS roads #231 and #2316 would be cleaned out. In RHCAs, MMC would not sidecast snow or surface materials.

Table 20. Proposed Road Improvements on NFS roads #231 and #2316.

Milepost from Junction with NFS Road #4778	Required Activity
MP 0.05	Install 24-inch ditch-relief culvert.
MP 0.10	Replace existing 18-inch corrugated metal pipe (CMP) with 24-inch CMP.
MP 0.13	Install 24-inch CMP. Scoured channel enters ditch; no pipe present to allow water to cross road.
MP 0.30	Install surface drainage. Drain to the east side of road.
MP 0.40	Surface drainage needed. Drain to the east.
MP 0.50	Lower existing 18-inch CMP and replace if necessary.
MP 0.60	Clean out existing CMP.
MP 0.70	Replace CMP and armor outlet.
MP 0.84	Replace existing CMP with a 24-inch CMP.
MP 0.90	Provide surface drainage needed; drain to south.
MP 0.91	Repair or replace existing 18-inch CMP inlet.
MP 1.03	Provide road surface drainage. Drain to the south.
MP 1.20	Provide road surface drainage. Drain to the south.
MP 1.30	Armor inlet of existing 24-inch CMP inlet.
MP 1.41	Install 24-inch CMP. Install a drainage ditch on MMC's Libby Adit road on private property.
MP 1.43	Provide road surface drainage. Drain to the south.

2.5.7.2.2 Bull Trout Critical Habitat

All action alternatives may reduce the flows in Rock Creek, East Fork Bull River, and Libby Creek. Mitigation of lower flows in Rock Creek and East Fork Bull River would focus on the East Fork Bull River and would consist of two parts: 1) completion of a comprehensive habitat survey and 2) construction of instream habitat structures. MMC would complete a comprehensive aquatic habitat survey from the confluence of the East Fork Bull River and Snake Creek up to the extent of fish habitat in East Fork Bull River (~1.3 miles past the CMW boundary; see Figure 35). MMC also would complete a comprehensive aquatic habitat survey in the reach of Libby Creek bordering MMC land that is downstream of the Little Cherry Creek confluence.

Following completion of the habitat inventories, MMC would prepare a stream improvement plan to increase the productivity and carrying capacity in portions of the streams targeted for mitigation. The plan would apply to the reach between the confluence of the East Fork and the North Fork East Fork Bull Rivers upstream to a location 0.5 mile into the CMW and the reach of Libby Creek downstream of the Little Cherry Creek confluence that borders land owned by MMC. The plan would be designed to meet INFS Riparian Management Objectives, to the extent feasible (Table 21). A component of the plan would be installation and maintenance of instream structures to form pool and deep water habitat, provide cover for subadults, and secure habitat for spawning adults. These would be built and maintained using appropriate-sized rock and large wood according to accepted methodologies. Vegetation removed in the Little Cherry Creek impoundment site could be used to provide large woody debris. Another component of the plan would be grade control structures to improve bedload transport, decrease width to depth ratios, and reduce fine sediment accumulation. These components would be modified as appropriate following the habitat survey.

Table 21. INFS Riparian Management Objectives and Existing Conditions in Area Streams.

Habitat Feature	Interim INFS RMO	Average Existing Condition		
		Libby Creek	Ramsey Creek	Poorman Creek
Pool Frequency (km)	35/km for 20-ft width	7	32	16
Large Pool Frequency (km)	NA	6	6	0
Water Temperature	< 15°C adult habitat, < 9°C	No data	10.2	5.4
Large Woody Debris (Forested)	> 32 pieces per km	23	116	163
Bank Stability (non-forested)	> 80 percent stable	100	99.3	100
Lower Bank Angle (non-forested)	> 75 percent of banks < 90º angle	Unknown		
Width/Depth Ratio	< 10	104.7	55.6	33.3

After the agencies' approval, MMC would implement the plan. As-built drawings and reference points would be established for all structures, which would be monitored and maintained for the life of the mine. Fish population monitoring would be conducted for the life of the mine to determine effectiveness of the stream improvement projects. Annual monitoring reports would be submitted to the agencies to document the completion of annual monitoring and mitigation effectiveness.

Structures would be monitored and maintained for the life of the mine. Population monitoring would be conducted for the life of the mine to determine effectiveness of the structures. Annual monitoring reports would be finalized and submitted to the agencies documenting the completion of annual monitoring and overall mitigation effectiveness annually.

2.5.7.2.3 Sediment

Plant site construction, road reconstruction, and road maintenance would generate sediment into project area streams. Mitigation would consist of a two-step process. MMC would initially identify existing sediment sources in Libby Creek particularly near the plant site and then off-site

in Ramsey, Poorman, or upper Libby creeks. After existing sediment sources were identified, MMC would develop sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sources. The inventory and proposed measures would be submitted to the KNF and FWP for approval prior to implementation.

The numbers of pools within the three reaches described by sites L9, Po1, and Ra2 are considerably lower than expected for streams that size (Figure 35). Mitigation at each site would consist of construction of three grade control structures to facilitate bedload transport and maintain an appropriate channel width. Additional work would include the construction of 15 habitat structures in each stream near the sample sites. The structures would increase the carrying capacity of stream habitat directly and indirectly affected by the construction and operation of the mine. Pools formed by the structures would be in excess of 2 feet deep and provide cover for sub adult rearing habitat as well as providing secure habitat for spawning adults. Existing nearby monitoring sites would be protected and left unchanged.

2.5.7.2.4 Monitoring

Fish population and comprehensive habitat assessments identifying sediment sources and structure sites would be completed prior to construction. Once completed, monitoring plans for fish populations and structure integrity would be developed and implemented to document mitigation implementation, determine effectiveness, and provide for adaptive management to ensure proposed mitigations are sufficient to minimize and offset effects of mine implementation.

2.5.7.3 Wildlife Mitigation

2.5.7.3.1 Grizzly Bear

In addition to access changes, MMC has prepared a plan to address wildlife issues related to the program. This plan was approved by the Forest Service. The objective of the plan is to identify wildlife issues, establish company procedures and protocols that address these issues, and develop employee and contractor awareness regarding wildlife issues. MMC would implement the following measures:

- No firearms would be permitted at the project site or along the Libby Creek access road by MMC, their contractors, or any subcontractors traveling to the project site
- Hunting would be prohibited on mine property
- Feeding of animals is prohibited
- Bear-proof garbage cans and/or dumpsters would be used on site, and garbage would be removed in a timely manner to avoid potential wildlife conflicts
- Private vehicles would be restricted from entering mine property
- The project area (private property) also would be fenced to prevent movement of big game animals onto the site

MMC has developed a wildlife awareness program to educate the current employees. MMC would continue to work in coordination with KNF and FWP on these and other similar programs. The following training includes:

- Bear awareness and safety
- Wildlife issues

- Refuse management
- Company policies on wildlife issues, firearms, and other related topics

In Alternative 2, MMC proposed the grizzly bear mitigation plan that was approved in the lead agencies' RODs and incorporated into DEQ Operating Permit #00150 (the "1992 Plan"). A number of roads proposed for access changes in the 1992 Plan are no longer available for mitigation. The lead agencies' mitigation plan would have similar components as the 1992 Plan: measures to reduce mortality risks, improve habitat effectiveness, and for mitigation plan management. The following mitigation plan completely replaces the grizzly bear mitigation plan proposed by MMC. Items in *italics* would be implemented prior to the evaluation phase.

This plan includes requirements for MMC to provide funding for a number of conservation measures that are needed long-term. Should future projects be proposed that have adverse effects on T&E species in the Cabinet-Yaak Ecosystem, funding for some of these measures could be required of the proponents, thus potentially changing the proportional funding required by MMC. Those items are marked with an asterisk **(*)** at the end of the measure description.

Measures to Reduce Mortality Risks

A. To reduce mortality risk (avoid incidental take) to Threatened and Endangered species, MMC would comply with the following, under the direction of the Forest Service:

1. *Develop a transportation plan designed to minimize mine related vehicular traffic, traveling between U.S. 2 and the mill site, and minimize parking availability at the plant site. Busing employees to the mill site, requirement for managers to car pool, and a supply staging area in Libby to consolidate shipments to the mine site would be a part of the plan. Forest Service approval would be required. The plan would be in place prior to the evaluation phase.*

2. *Not use salt when sanding during winter plowing operations to reduce attracting big game, which can result in vehicles killing them. That in turn could draw lynx and grizzly bears to the road corridor and increase mortality risk.*

3. *Remove vehicular-killed big game animals daily from road rights-of-way within the permit area and along roadways used for access or hauling ore (NFS roads #231, #278, #4781, and #2316 and new roads built for the project). Road-killed animals would be moved at least 50 feet beyond the right-of-way clearing or as far as necessary to be out of sight from the road. During construction and the first 3 years of mill operations, MMC would monitor the number of big game animals killed by vehicle collisions on these roads and report findings annually. The numbers of animals killed by vehicle collisions would be reviewed by the KNF, in cooperation with the FWP, and if necessary, mitigation measures would be developed and implemented to reduce mortality risks. MMC also would monitor and report (within 24 hours) all grizzly bear, lynx, wolf, and black bear mortalities within the permit area and along the access roads. If a T&E species mortality occurred, and the grizzly bear specialists or law enforcement officer felt it were necessary to avoid grizzly bear or other T&E species mortality, MMC would be required to haul the road-killed animals to a disposal location approved by FWP.*

4. Fund a local MFWP Habitat Conservation Specialist position to aid in grizzly bear conservation for the life of the mine. This would be a new position stationed in a location that serves Lincoln and Sanders counties. Funding would be provided prior to starting the

construction phase to cover the first 5 years and then in 5-year increments until the mine project was completed, including reclamation. The purpose of the position is to identify, evaluate, prioritize, and conserve wildlife habitats for species affected by development and operation of the Montanore mine, with an emphasis on grizzly bears. The position will work with Lincoln and Sanders counties' planning staff to ensure that county land use decisions consider current wildlife information. The position description and an initial list of work items will be developed jointly by the agencies (including, but not limited to Forest Service, USFWS, and FWP) and MMC representatives. The Forest Service will request review and advice from the USFWS on the position description and list of work items.

5. *Fund a local FWP law enforcement position for the life of the mine. This position may be new or existing and would be determined by FWP and USFWS. Funding to cover the first 5 years would be provided prior to starting the evaluation phase. The position would be stationed in Fisher River side of the ecosystem. The position description and an initial list of work items would be developed by the agencies (Forest Service and FWP) and MMC representatives. The Forest Service would request review and advice from the USFWS on the position description and list of work items.*

6. Prior to the construction phase, MMC would:

    a) In order to proceed with the construction phase, agree to defer the construction phase of the mine until at least six female grizzly bears have been augmented into the Cabinet Mountains portion of the Recovery Zone (south of U.S. 2). Female grizzly bears placed in the Cabinet Mountains on or after 10/01/2005 count toward this requirement. As of November 2008, four female bears have been placed in the Cabinets. Two of these bears were killed in October 2008 (Kasworm 2008).

    b) In coordination the KNF and Montana FWP, fund and/or conduct an enhanced outreach and education program to build support and understanding for the conservation of the Cabinet-Yaak grizzly population. This would involve educational materials, public service announcements, newspaper ads, and billboards supporting grizzly conservation. Examples could be signs at entrance roads to all grizzly habitats on the National Forest, education programs for schools and civic clubs, and offering a reward leading to arrest and conviction of people illegally killing grizzly bears in the Cabinet-Yaak Ecosystem. (*)

    c) Coordinate with the bear specialist to provide funding for bear resistant garbage containers for personal use by all mine employees associated with the evaluation, construction, and operation phases who live in or near grizzly bear habitat. *Thirty-five of these containers would be placed at the Libby Adit prior to the evaluation phase.*

    d) Provide funding for a second bear specialist in Libby for the life of mine, similar to position described in #5 above. This position may be new or existing, and would be determined by FWP and USFWS. Initial funding to cover first 5 years of the position provided prior to construction start-up. (*)

    e) Provide funding for an additional 100 bear-resistant garbage containers plus an additional 20 per year, after the first year of construction phase, for distribution to the community at large by the grizzly bear management specialists.

f) Coordinate with bear specialists, USFWS, and Lincoln County to prioritize and provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem. MMC would provide funding for and work with the USFWS and Lincoln County to make garbage collection site(s) bear resistant prior to start of construction start up. (*)

g) *Fund an initial 10 electric fencing kits for use at bear problem sites that can be installed by FWP bear specialists*, and then 2 replacements per year, for use as needed. (*)

h) *Agree that all mortality reduction measures would be subject to modification based on adaptive management, where new information supports changes. Modifications would be reviewed and approved by the Oversight Committee.*

7. The Forest Service would ensure that the law enforcement and information and education positions (grizzly bear personnel) required in the revised mitigation plan comply with the following:

   a) Positions would be located in the Fisher River side of the ecosystem.
   b) Grizzly bear personnel would be new or existing positions with FWP as determined by FWP and USFWS.
   c) Funding intended for the grizzly bear personnel positions would not be used to support already existing positions with FWP that are not performing duties of a grizzly bear specialist.
   d) Duties for the law enforcement position would be designed at a State grade determined by FWP (recommend at least a grade 14) and would be primarily directed at wildlife issues in the Cabinet Mountains portion of the Cabinet-Yaak Ecosystem.
   e) Duties for the bear specialist positions would be designed as a grizzly bear management specialist at a State grade determined by FWP (recommend at least a grade 14) and would be specifically tied to bear activities in the Cabinet Mountains portion of the Cabinet-Yaak Ecosystem.
   f) Grizzly bear personnel would be fully funded for the life of the mine through the reclamation period and including shut-down periods to provide for long-term consistency, the establishment of relationships with the resident public, familiarity with issues and potential problems in the area, and to address the large number of people who may remain in the area even in the event of temporary mine shut-downs.
   g) Grizzly bear personnel would be operational, with all supportive equipment, vehicles and gear, prior to the letter to proceed on the construction phase.
   h) Establish and maintain (through coordination with the three grizzly bear personnel: 2 specialists and 1 law enforcement officer) a mandatory reporting system to ensure that MMC and Forest Service employees are required to immediately report any black bear or grizzly bear incidents, observations or mortalities to both grizzly bear personnel to ensure that preemptive management, hazing, or removal of food attractants would occur to avoid risks of habituation, mortality or displacement of grizzly bears. The reporting system also would be coordinated with the FWP grizzly bear management specialist in Libby and would provide a mechanism to collect reliable information from the public on such incidents, although such reporting could not be required.

8. Use bear-resistant containers to hold attractants at all Montanore mine facilities. Remove contents in a timely manner (weekly unless a problem develops or grizzly bear personnel recommend a more frequent schedule). Containers would be in place at each mine facility site prior to starting any work on each site. *One of these containers would be placed at the Libby Adit prior to the evaluation phase.*

9. Avoid the use of clovers or other plants attractive to black or grizzly bears in the seed mix used on open roadways or any facility associated with the Montanore Mine (except as rehabilitation on closed roads or mitigation habitat where attracting bears would be encouraged).

10. *Prohibit employees from carrying firearms within the permit area, except for security officers and other designated personnel. Identify consequences for violations in the an employment contract so employees would be aware of consequences prior to beginning their employment.*

11. *Prohibit employees from feeding wildlife (including dropping food stuffs from lunches, etc.) within the permit area to avoid attracting bears or other wildlife into conflicts with people and encouraging habituation. Identify consequences for violations in an employment contract so employees would be aware of consequences prior to beginning their employment.*

12. Fund the acquisition of bear resistant garbage containers to be placed in all developed campgrounds within Bear Management Units 1, 2, 3, 4, 5, 6, 7, 8, and 9 (pack in/pack out sites would not require garbage containers). The Forest Service would ensure that MMC provide bear resistant garbage receptacles for all Forest Service campgrounds and sites where garbage facilities are normally provided within the Cabinet portion of the Cabinet-Yaak Ecosystem recovery zone (in BMUs 1-9). This includes those in MS-3 habitat, which often serve as the greatest risk to habituate bears and increase risk of bear removal through defense of life or property incidents or management action.(*)

13. *Require mine employees (including all management staff) to attend training related to living and working in grizzly bear habitat prior to starting work and on an annual basis thereafter or as scheduled by the grizzly bear management personnel.*

Habitat Effectiveness

Habitat effectiveness is defined as the ability of habitat to support grizzly bears based on habitat productivity and security. Habitat security is reduced by major human activities that may result in the displacement of grizzly bears from otherwise suitable habitat. Habitat effectiveness is described in greater detail in section 3.24, *Wildlife Resources*.

B. To maintain habitat effectiveness and reduce the likelihood of adverse effects on Threatened and Endangered species, MMC would, under the direction of the Forest Service,

1. Secure or protect (through conservation easement, road access changes, or acquisition in fee with conveyance of fee or perpetual conservation easement to the Forest Service) from development (including but not limited to housing and motorized access) and use (timber harvest, grazing, and mining) replacement habitat to compensate for acres lost by physical alterations, or acres with reduced habitat availability due to disturbance. Replacement acres for the agencies' alternatives are for physical loss and for disturbance. They would be "in kind" replacement acres. Replacement habitat would be provided using the following

schedule in Table 22. This schedule would have all replacement habitats in place prior to starting mill operations.

Table 22. Required Replacement Acreage.

Alternative	Replacement Acres		Timing
	Physical Loss[†]	Disturbance[‡]	
All agencies' alternatives		2,880	Prior to Evaluation Phase
3 C	4,022	19,338	Prior to Construction
3 D	4,025	20,045	Prior to Construction
3 E	4,026	22,300	Prior to Construction
4 C	4,494	19,647	Prior to Construction
4 D	4,497	20,354	Prior to Construction
4 E	4,498	22,609	Prior to Construction

[†]Requires conservation easement or acquisition; mitigation requirement is shown at 2 to 1 ratio
[‡]May be conservation easement, acquisition, or habitat enhancement; mitigation requirement is shown at 1:1 ratio (see mitigation items B2, C1, and D1 below for planned measures toward meeting this requirement)
[§]Mitigation required for use of existing roads (about 15 percent of the disturbance replacement acres) would be needed before start of mill operations; replacement habitat for the ventilation adit would be in place prior to its construction, if the adit became necessary.

Either fee title or conservation easements would be acceptable. Conservation easements would be in perpetuity and transferred to the Forest Service. If fee lands were retained in private (not federal ownership) a conservation easement protecting the land in perpetuity must be conveyed to the Forest Service. Fee title lands may be considered for donation or land exchange with the Forest Service. Costs of processing land exchanges, and preparing and accepting conservation easement by the Forest Service for these acres would be funded by MMC. Land exchanges would be for equal valued lands as determined by a federal land appraisal. Any exchange must be beneficial to the Forest Service. First choice for replacement habitat would be within the disturbed BMUs (2, 5, and 6). If adequate replacement acres were not available in those BMUs, then lands may be located in other BMUs (1, 4, 7, and 8) within the Cabinet Mountains.

The USFWS would be consulted with and asked advice on the mitigation acres and associated conservation easements as they relate to the requirements included in the Biological Opinion on the Montanore Mine, at an early stage in the acquisition negotiations. Forest Service would have final approval of mitigation acres and associated conservation easements prior to closing and recording.

The Forest Service would ensure that the specified acres (Table 22) of mitigation properties be managed for grizzly bear habitat in perpetuity. Properties acquired in fee by MMC must either be transferred to the Forest Service or must be protected by perpetual conservation easement transferred to the Forest Service. Easement properties acquired by MMC must be transferred to the Forest Service. The specified acres of mitigation properties must meet the following requirements:

a) The USFWS would be requested to advise the Forest Service if it believed the proposed mitigation properties met one or more of the following:

   i restores or improves bear security habitat (HE and core) in the Cabinet Mountains, particularly in the constricted north-south grizzly bear movement corridor;
   ii improves habitat conditions related to established access standards in BMUs 2, 5, and 6;
   iii reduces existing threats of development, food attractants or mortality risks in the Cabinets;
   iv reduces potential threats of development, food attractants or mortality risks in the Cabinets;
   v protect seasonally important habitats, with an primary emphasis on spring, and secondary emphasis on fall habitats; and/or
   vi would maintain or increase MS-1 habitat (including the potential of acquiring and converting MS-3 properties or lands adjacent to the Cabinet-Yaak Ecosystem recovery zone that have high mortality risks to MS-1 if those risks could be eliminated under federal ownership);

b) Fee-title properties or transfers (trades) of National Forest System lands must meet standards, requirements, and legal processes for federal acquisition or trade, including, but not limited to:

   i approval by the Office of General Counsel;
   ii be a Warranty Deed conveyance;
   iii comply with Department of Justice standards;
   iv be free of hazardous materials, or develop an agreement among MOU signers as to appropriate remedy prior to acquisition;
   v include all surface and sub-surface rights including rights-of-ways, mineral claims, and/or other easements, unless otherwise advised by the USFWS;
   vi be acquired in priority order. Lower priority acquisitions may be allowed, after approval of the Forest Service and when consistent with advice from the USFWS to ensure that such a property would contribute to meeting the requirements of the Biological Opinion;
   vii meet fair market appraised value, according to Forest Service appraisal processes with the allowance that MMC could contribute additional funds to facilitate unequal appraised value trades, as approved by the Management Plan. Advanced approval by the Forest Service, after consultation with the USFWS regarding the ability of the proposed lands to meet the requirements of the Biological Opinion, is required; and
   viii be acquired and recorded prior to the letter to proceed on the associated phase of the mine, with total acquisitions completed prior to the letter to proceed on the construction phase of the mine.

c) Conservation easements must include language approved in the Management Plan and meet standards, requirements and legal processes for federal acquisition or trade, including, but not limited to:

   i approval by the Office of General Counsel;
   ii have the conservation easement be attached to the Warranty Deed;

iii comply with Department of Justice standards;

iv be free of hazardous materials, or develop an agreement among MOU signers as to appropriate remedy prior to acquisition;

v Include all surface and sub-surface rights including rights-of-ways, mineral claims, and/or other easements, unless otherwise advised by the USFWS;

vi be acquired in priority order. Lower priority acquisitions may be allowed, when consistent with advice from the USFWS to ensure that such a property would contribute to avoiding jeopardy;

vii meet fair market appraised value, according to Forest Service appraisal processes with the allowance that MMC could contribute additional funds to facilitate unequal appraised value trades, as approved by the Management Plan if the affected parcels were consistent with advice from the USFWS as being important to avoid jeopardy; and

viii be acquired and recorded prior to the letter to proceed on the associated phase of the mine, with all mitigation habitat acquired and recorded prior to the letter to proceed on the construction phase of the mine, excepting the mitigation habitat that may be necessary in the event the ventilation adit is required. Mitigation habitat for the ventilation adit would be acquired prior to the letter to proceed on development of the ventilation adit, should it be necessary.

The Forest Service would implement access management improvements on lands acquired in the revised mitigation plan. The USFWS requires specific mitigation properties to be acquired to improve habitat security; core area; total motorized route density; and open motorized route density and would assess other areas prior to acquisition to ensure these lands would be sufficient to avoid jeopardizing the Cabinet-Yaak Ecosystem grizzly bear population. These specific areas would be withheld from public disclosure due to their sensitive nature until acquisitions have been finalized.

The USFWS agrees to work with the Forest Service in determining how road management associated with that property can improve access standards, with the goal of managing BMUs 2, 5, and 6 above levels identified by research (Wakkinen and Kasworm 1997). The USFWS believes the disturbances as expected with the Montanore Mine necessitate access management at a conservative level while the disturbance is ongoing. The acquisition of mitigation habitat may provide opportunities to manage access management at these levels in BMUs 2, 5, and/or 6. Should mitigation property be acquired that would enable access management at these levels, the USFWS expects that the Forest Service would provide the bears using BMUs 2, 5, and 6 the optimum level of access management to reduce displacement and mortality risks during the life of the mine.

2. Fund habitat enhancement, commensurate with loss of habitat effectiveness (Table 23). Enhancements include, but are not limited to, prescribed fire to restore whitebark pine, road access changes, and obliterations. Enhancements are preferred in the affected BMUs; if opportunities were not available, then enhancement may be done in BMUs in other portions of the Cabinet Mountains. Generally enhancements would occur in relation to replacement habitat acres. Enhancements associated with replacement acres would occur in a timely manner as agreed to by the agencies.

Table 23. Required Acreage for Reduced Habitat Effectiveness.

Mine and Transmission Line Alternative Combination	BMU (#)	H.E. Change (%)	Habitat Effectiveness Mitigation (acres)
3C	5	-6	4,481
3C	6	-4	2,489
3D	5	-6	4,401
3D	6	-5	2,757
3E	5	-6	4,401
3E	6	-7	4,019
4C	5	-6	4,361
4C	6	-4	2,489
4D	5	-6	4,282
4D	6	-5	2,756
4E	5	-6	4,282
4E	6	-7	4,019

These acres may also count toward the disturbance mitigation requirement (Table 22).

C. To reduce mortality risk, maintain habitat effectiveness, reduce incidental take, and avoid jeopardy for Threatened and Endangered species the KNF, with MMC funds, would:

1. Change the access of the following roads prior to the start of the Libby Adit evaluation program (Table 24) and prior to the start of construction phase (Table 25) (Figure 36); monitor the effectiveness of closure device at least twice annually, and complete any necessary repairs immediately. Roads shown in Table 24 that would be seasonally gated would provide 1,810 acres of spring grizzly bear habitat. The acres of mitigation credit provided by the other road access changes shown in Table 24 and Table 25 would be core acres created following installation of gates, road decommissioning, or long-term storage. For all agencies' alternatives, access changes during the Libby Adit Evaluation Program would create 2,554 acres of core habitat. Road access changes during full project construction and operations would create an additional 2,077 acres of core in Alternatives 3/4 C, and 3,096 acres in Alternatives 3/4 D and E. Total core created would be 4,631 acres in Alternatives 3/4 C, and 5,650 acres in Alternatives 3/4 D and E. Because core habitat provides the highest quality conditions and would be better than the non-core acres affected by the project, mitigation credit is given at 2:1 ratio. Therefore, the 4,631 and 5,650 acres of core created also count as 9,262 and 11,300 acres, respectively, of mitigation toward the disturbance mitigation acre requirement (see Table 22).

2. Implement a mandatory food storage order for BMUs 2, 5, and 6 prior to allowing MMC to start the construction phase, and implement same order throughout the Cabinet-Yaak Ecosystem within 5 years of construction completion.

Table 24. KNF's Proposed Access Changes for Grizzly Bear Mitigation Prior to Libby Adit Evaluation Program.

Road Number	Road Name	Miles	Current Access Status	Proposed Access Status	Period	Notes
231 2316	Libby Creek Road; Upper Libby Creek	2.0 1.5	Open	Gated seasonally	April 1 to May 15	Mine traffic only during closure period
4778 4778E 5192 5192A	Midas-Howard Creek Midas-Howard Creek E Midas Bowl Midas Bowl A	6.7 0.8 1.6 0.2	Open	Gated seasonally	April 1 to June 15	No snow vehicles during closure
4776A 4778C	Horse Mtn Lookout A Midas Howard Creek C	2.7 1.9	Open	Barriered	Year-long	Open to over snow vehicles Dec. 1 to March 31.
4778C	Midas Howard Creek C	1.5	Gated	Barriered	Year-long	Open to over snow vehicles Dec. 1 to March 31.
14458	Midasize	0.6	Open	Barriered	Year-long	No snow vehicles
4776C 4776F 6200 6200D 6200E 6200F 6214 6214F	Horse Mtn Lookout C Horse Mtn Lookout F Granite-Bear Creek Granite-Bear Creek D Granite-Bear Creek E Granite-Bear Creek F Cable-Poorman Creek Cable-Poorman Creek F	0.9 1.1 1.8 0.9 0.3 0.4 3.6 0.6	Gated	Barriered	Year-long	Open to over snow vehicles Dec. 1 to March 31.
6745[†]	Standard Creek	3.9	Gated	Barriered	Year-long	KNF would maintain as a trail; no snow vehicles

[†]The Standard Creek road #6745 is currently maintained as a trail. Road storage work would maintain this road as a trail while stabilizing the road hydrologically.

Table 25. KNF's Proposed Road Access Changes for Grizzly Bear Mitigation Prior to Full Project Construction.

Road Number	Road Name	Miles	Current Access Status	Proposed Access Status	Period	Notes
2316 6702	Upper Libby Creek; South Upper Libby Creek	0.7 1.1	Gated	Barriered	Year-long	Restricted year-long to all motorized vehicles
4781 6701	Ramsey Creek; South Ramsey Creek	2.8 0.4	Gated	Barriered	Year-long	Restricted year-long to all motorized vehicles
4725†	North Fork Miller Creek	Alt 3/4C 2.8 Alt 3/4D 4.2 Alt 3/4 E 4.2	Gated	Barriered	Year-long	Restricted year-long to all motorized vehicles
2317	Poorman Creek	1.8	No restrictions on motorized vehicle use	Barriered	Year-long	Restricted year-long to all motorized vehicles

†Access on Road 4725 changed following completion of transmission line construction in Alternatives 3C and 4C.

3. In coordination with the FWP and USFWS, the Forest Service would prioritize lands for conservation easement or acquisition in key linkage areas, identified by research and/or monitoring, that extend east between the Cabinet-Yaak Ecosystem and the Northern Continental Divide Ecosystem. Up to one-half of replacement acres for disturbance mitigation may be in this linkage area.

4. The Forest Service would coordinate with the USFWS and FWP on release sites for augmentation of grizzly bears on National Forest System lands.

5. Prior to the start of the construction phase, MMC would provide funding for bear monitoring in the area along U.S. 2 between the Cabinets and the Yaak River and/or the area between the Cabinet-Yaak Ecosystem and Northern Continental Divide Ecosystem as identified by FWP. The linkage identification work along U.S. 2 would involve 3 years of monitoring movements of grizzly and black bears along the highway to identify movement patterns and key movement sites. Funding would cover aerial flights for 2 hours per week, 30 weeks per year for 3 years, salary for one seasonal worker for 6 month per year for 3 years, salary for one GIS technician for 6 months per year for 3 years and 10 GPS collars, and collar rebuilds each year for 3 years. **(*)**

D. To address habitat constriction that reduces the potential to achieve Cabinet-Yaak Ecosystem grizzly bear recovery goals (by impacting individuals in the Cabinet Mountains) and to avoid jeopardy, MMC would:

1. Secure or protect (through conservation easement, including motorized route access changes) or acquisition in fee with conveyance of fee or perpetual conservation easement to the Forest Service from development (including but not limited to housing, motorized access) and use (timber harvest, grazing, and mining) about 5 acres near Rock Lake Meadows (T.26N., R.31W. NW ¼ section 6) of replacement habitat that would enhance the north to south habitat corridor in the Cabinet Mountains. These lands are in addition to those identified under mitigation item B-1. All acres of replacement habitat for the constriction impact would be secured prior to starting the construction phase. These lands would be placed in public ownership either through donation or land exchange. Costs of processing land exchanges, and preparing and accepting conservation easement by the Forest Service for these acres would be funded by MMC. All land interest conveyed to the Forest Service must be acceptable and approved by the Office of General Counsel. Fee title land must be conveyed by Warranty Deed in accordance with Department of Justice standards. All property or interest in property, would be inspected for hazardous substances in accordance with law, regulation, and policy. If hazardous substances were found, an agreement needs to be reached on removal and remedial action. The property is located in the East Fork Rock Creek drainage and is accessed by motorized trail #935.

   MMC would provide funding for the Forest Service to create core habitat for grizzly bear along trail #935 (Figure 36). This would include but is not limited to: removal of motorized vehicle bridges, replacement foot traffic bridges, replacing gate at trailhead with a barrier, and conversion of motorized trail tread to foot traffic tread conditions. This measure provides 1,220 acres of core habitat. Because the created habitat would be core habitat, these acres would count as 2,440 acres of mitigation toward the disturbance mitigation requirement shown in Table 22.

The Forest Service would ensure that, for the 5 acres of mitigation habitat required to enhance the north-south corridor in the Cabinet Mountains:

a) the fee title or perpetual conservation easement to the 5 acres of mitigation property, be acquired by or transferred to the Forest Service;
b) include the specific properties identified by the USFWS to avoid jeopardy (which would be released to the public when acquisition has been completed and recorded);
c) the Forest Service would request that the USFWS advise the agency as to whether the proposed acres meet the requirements of the Biological Opinion, and once confirmed, would be acquired and recorded prior to the letter to proceed on the construction phase;
d) be managed as grizzly bear security habitat (core) throughout the life of the mine, including the reclamation period and any temporary or extended shutdown periods, and thereafter managed in a manner consistent with grizzly bear conservation requirements;
e) maintain or improve existing baseline core conditions; and
f) have any habitat enhancement activities needed to improve the mitigation properties, such as the trail conversion, be planned and funded prior to the letter to proceed on the associated phase of the mine. Implementation would occur as soon as feasible (*e.g.*, upon completion of any required NEPA process).

E. To assure compliance with the T&E species mitigation plan, and effectiveness of the management plan, the Forest Service or MMC would:

1. Prior to the construction phase,

   a) MMC would establish a trust fund and/or post a bond, to cover the mitigation plan implementation costs. The amount in the fund or posted in a bond would be commensurate with projected work and associated required mitigation items. The Oversight Committee would determine the amount of trust fund deposits, to be made in 5-year increments over the life of the mine.

   b) Forest Service would lead a stakeholders information annual meeting. Stakeholders may include, but not limited to state and federal agencies, county commissioners, mining company, local citizen, and non-governmental organizations representatives. The objectives of the meetings are to review a) management objectives, b) implementation of mitigation measures, and c) monitoring and research results.

   c) Forest Service would agree to adopt management actions in response to new information from monitoring to assure that on going management meets the objectives for grizzly bears in the Cabinet-Yaak Ecosystem.

2. Participate in the development of and be a signer on a Memorandum of Understanding (MOU):

   The Forest Service would develop an MOU with FWP, MMC, and other parties deemed appropriate by the Forest Service. The MOU must be completed prior to the Forest Service issuing MMC the letter to proceed with the construction phase. The MOU would establish roles, responsibilities, and time lines of an Oversight Committee comprised of members of the Forest Service, FWP, and other parties deemed appropriate by the parties named. The

USFWS would be an ex-officio, non-voting member of the Oversight Committee, with only advisory responsibilities.

The Oversight Committee would be responsible for the development of a Comprehensive Grizzly Bear Management Plan and its implementation. The Comprehensive Grizzly Bear Management Plan would focus on the Cabinet portion of the Cabinet-Yaak Ecosystem and would fully include all provisions of the Forest's mitigation plan for grizzly bears, except where superseded by the USFWS' Biological Opinion. It also would include provisions for adaptive management. The plan would be developed in detail by the parties to assure that human access to grizzly bear habitat, grizzly bear habitat quality, grizzly bear mortality, and habitat fragmentation issues would be addressed to the extent that jeopardy would be avoided. Advice and comments on the plan from the USFWS would be requested and fully considered, including advice on whether the plan would meet the requirements of the Biological Opinion.

The Oversight Committee, led by the Forest Service, would over the life of the mine:

a) assume responsibility for coordinating various aspects of the Management Plan;
b) assume responsibility for maintaining effective communication among all Committee members, stake holders, and interested public; and
c) integrate the principles of adaptive management; collect, disseminate where needed, and review new information on grizzly bears; the results of implementation of the Comprehensive Grizzly Bear Management Plan over time; and other information related to Cabinet-Yaak Ecosystem grizzly bears. Based on new information, if appropriate to ensure the proposed action is not likely to jeopardize the Cabinet-Yaak Ecosystem grizzly bear population, conduct additional analyses or develop recommendations for modifications of the mitigation plan to be implemented during the life of the mine. The USFWS would be asked to review proposed revisions to the Comprehensive Grizzly Bear Management Plan under appropriate section 7 provisions, if required.

The USFWS would be an advisor in the development of the MOU and subsequent Comprehensive Grizzly Bear Management Plan, and the Forest Service would request that the USFWS advise, in writing, that the plan would meet the requirements of the Biological Opinion.

The MOU would be completed prior to proceeding on the construction phase and require the Forest Service to:

1. Ensure the Management Plan is completed prior to the construction phase of the mine.
2. Establish time frames for mitigation and implementation of other management to occur prior to the letter to proceed on the phase of the mine associated with that mitigation or management activity.
3. Ensure adequate funding, from MMC, to implement the mitigation plan according to the time frames.
4. Comply with legal guidelines or processes in as timely manner as possible in order to meet the mitigation plan and/or Comprehensive Grizzly Bear Management Plan implementation schedule.

5. Ensure that the USFWS is consulted on the mitigation properties and the Comprehensive Grizzly Bear Management Plan and the USFWS is requested to advise the Forest Service if the properties and the Plan meet the requirements in the Biological Opinion. All mitigation properties not specifically mentioned would have undergone all necessary procedures for procurement including recordation, prior to the agencies' letter to proceed on the associated phase of the mine.

6. Establish language and legal procedures to ensure that mitigation properties acquired through fee title, land transfer, or conservation easement:

    a) would be perpetual;
    b) would meet federal policies and regulations regarding such realty actions;
    c) have the USFWS advise whether they would meet the Biological Opinion requirements;
    d) would be implemented and recorded in advance of the phase of the mine with which they are associated;
    e) would increase or at least maintain a no net loss of MS-1 Cabinet-Yaak Ecosystem habitat;
    f) would be adequately funded such that enforcement of easement terms is assured;
    g) would be selected on a priority basis with biologically justifiable rationale and the USFWS advice that they meet the requirements included in the Biological Opinion; and
    h) would ensure management in support of grizzly bear survival and recovery if in public ownership.

The Comprehensive Grizzly Bear Management Plan would include the measures in the mitigation plan, except where the mitigation plan has been superseded by the USFWS' Biological Opinion. In addition, processes would be established to ensure that access management, prevention of habituation, educational opportunities, reporting and monitoring, enforcement of easements, and management actions are being adequately implemented. Further, the Comprehensive Grizzly Bear Management Plan would establish processes to revise management, access, education, or habitat enhancement strategies as new research or policies, such as revised IGBC guidelines.

3. Contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of mitigation measures implemented to provide a secure north to south movement corridor. The Forest Service would ensure that adequate funding, provided by MMC, is available to monitor bear movements and use of the Cabinet Mountains to confirm the effective implementation of mitigation measures. Information gained would be useful in determining whether the mitigation plan is working as intended. If not, the information would help in developing new management strategies that would be incorporated in the Biological Opinion through appropriate amendments. Funding would supplement ongoing research and monitoring activities in the Cabinet-Yaak Ecosystem, would be conducted or coordinated by the USFWS' grizzly bear researcher in Libby or the equivalent, and would focus on grizzly bears in the Cabinet Mountains. Funding would include money for the following (but not limited to): trapping, hair sampling and analysis, radio collars, flight time, monitoring native and augmented grizzly bears, and data analysis, including all equipment and support materials needed for such monitoring. The

Forest Service would ensure that funding, provided by MMC, is available on an annual basis, 2 months in advance of the fiscal year (October) of the year it is to be used for the life of the mine. Details of the monitoring activities and budget would be outlined in the Management Plan. Funding would be provided prior to starting the construction phase and would continue throughout the life of the mine through the reclamation phase. (*)

2.5.7.3.2 Key Habitats

Mitigation common to both the mine and transmission line alternatives is discussed in the following sections. Wildlife mitigation specific to the transmission line is discussed in section 2.9.4, *Wildlife Mitigation Measures*.

Old Growth

The KNF would designate effective or replacement old growth on National Forest System lands within the affected PSUs (first priority) or adjacent PSUs (second priority) at a 2:1 ratio for old growth within the disturbance area of the mine Alternatives 3 or 4, or the clearing width of transmission line Alternatives C, D or E (Table 26). Similarly, the KNF would designate effective or replacement old growth on National Forest System lands at a 1:1 ratio for old growth affected by "edge effect" or designated old growth within areas newly designated MA 31 not already accounted for by edge effect (see section 2.12, *Forest Plan Amendment*). Specifically, this would consist of old growth between the proposed mine facilities disturbance and permit area boundaries. Any private land acquisition for grizzly bear habitat mitigation could also be used to offset habitat loss, if old growth habitat characteristics were present on the acquired parcels.

Table 26. Old Growth Designation Requirements by Mine and Transmission Line Alternative Combination.

Old Growth Impact	Combined Alternative					
	3C	3D	3E	4C	4D	4E
Physical Acres[†]	382	392	392	366	376	376
Edge Acres	190	205	205	150	165	165
Acres Changed to MA 31[‡]	54	54	54	182	182	182
Total Designation	626	651	651	698	723	723

[†]Physical acres shown equals twice the acres that would be removed.
[‡]Designated old growth reallocated to MA31 but not included in disturbance area or edge effect. No physical changes would occur to old growth in these areas.

MMC would be restricted in timing of removal of old growth habitat (effective or replacement). No vegetation clearing requiring tree removal would occur between April 1 and July 15 to avoid direct mortality to active nest sites for bird species using old growth habitat, such as pileated woodpecker. This restriction would be incorporated into the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*).

Snags (Cavity Habitat)

MME would leave snags within the disturbance area of the mine Alternatives 3 or 4, or the clearing width of transmission line Alternative C, D, or E, unless required to be removed for safety or operational reasons. For example, snags would be left in the LAD Areas where selective

tree thinning would be required. This mitigation would be incorporated into the Vegetation Removal and Disposition Plan, section 2.5.3.2.1, *Vegetation Removal and Disposition*.

2.5.7.3.3 Indicator Species

Big Game

The KNF would change the access of the following roads year-long by earthen barrier to mitigate for the loss of big game security (Figure 36). The roads would be either placed in intermittent stored status or decommissioned.

- Road 4776B Horse Mountain (2.8 miles)
- Road 6209E Crazyman Creek (1.1 miles)
- Road 14442 Lampton Pond (0.6 mile)

The KNF also would mitigate for the loss of big game security by gating and changing the access year-long the roads listed below (Figure 36).

- Road 6205D Big Hoodoo (4.0 miles)
- Road 6787B Hoodoo Bear (1.6 miles)

Mountain Goat

MMC would fund surveys to monitor mountain goats to examine response to mine-related impacts. The surveys would be integrated into the current monitoring effort of the FWP. Aerial surveys would be conducted three times annually (winter-late spring-fall) by the FWP along the east front of the Cabinet Mountains from the Bear Creek drainage south to the West Fisher drainage. Surveys would be conducted for 2 consecutive years prior to construction, and every year during construction activities. Survey results would be analyzed by the KNF, in cooperation with the FWP, at the end of the construction period to determine the appropriate level and type of survey work needed during the operations phase. If the agencies determined that construction disturbance were significantly impacting goat populations, mitigation measures would be developed and implemented to reduce the impacts of mine disturbance. Surveys would be conducted using the current protocol of the FWP. Currently, the FWP conducts one aerial survey of the east Cabinet Mountains every other year. This additional level of monitoring would provide information on the status of mountain goat use adjacent to the project area, and potential effects of the project.

MMC would not conduct any blasting at the entrance to any adit portals during June 1 to June 30 to avoid disturbance to the potential goat kidding area on Shaw Mountain.

Forest Sensitive Birds and State Bird Species of Concern

MMC would implement the following measures to reduce the effects on Forest sensitive species and State species of concern, such as the flammulated owl, black-backed woodpecker, and northern goshawk. One of two options would be used in migratory bird habitat prior to vegetation clearing. In Option 1, MMC would not remove vegetation in the nesting season to avoid direct mortality at active nest sites. In Option 2, MMC would complete surveys to locate active nests in appropriate habitat. Surveys would be conducted one nesting season before construction activities on National Forest System lands. These measures could also be applied to private land to satisfy the requirements of the MFSA to minimize adverse environmental impacts. If an active nest were

found, an area surrounding the nest would be delineated and not disturbed until after the young fledged. Survey protocols and avoidance areas for specific species are described in Table 27.

Table 27. Forest Sensitive Birds and State Bird Species of Concern Survey Protocols, Alternatives 3, 4, C, D, and E.

Species	Avoidance Period (Option 1)	Option 2		
		Survey Period	Protocol Reference	Avoidance Area† (acres)
Flammulated Owl	May 15 to July 15	May 15 to July 15	Bull *et al.* (1990)	40
Black-backed Woodpecker	April 15 to July 15	April 15 to July 15	Bull *et al.* (1990)	175
Northern Goshawk	May 15 to July 15	May 15 to July 15	USDA Forest Service (2005a)	500-600

†For flammulated owl, based on Hayward and Verner 1994; for black-backed woodpecker, based on Cherry 1997; for northern goshawk, based on Reynolds *et al.* 1992.

Migratory Birds

MMC would either fund or conduct monitoring of landbird populations annually on two, standard Region One monitoring transects within the Crazy and Silverfish PSUs. The Poorman Transect (480-811-533) is located adjacent (slightly northwest) of the LAD Area 1, and the Miller Creek Transect (480-411-527) is located slightly southeast of transmission line Alternative D. Currently, the KNF conducts monitoring every other year on these two transects as part of the Region One Landbird Monitoring Program. Monitoring has been conducted since 1994, and would be continued using the standard Region One Landbird Monitoring Protocol (USDA Forest Service 1998b). This effort could be integrated into the current Region One monitoring program, or could be contracted by MMC. This monitoring effort would continue to provide data on bird species composition along with population trend data in the two PSUs where project activities are proposed.

Migratory songbirds would be monitored in the LAD Areas in Alternatives 3 or 4 to examine mine-related impacts to breeding birds within the treatment areas. MMC would fund the required monitoring work. Monitoring would be conducted for 2 consecutive years (to establish baseline data) prior to construction, every year during LAD site construction activities, and for the first 5 years of the operation period. Monitoring results would be analyzed at the end of this period to determine the appropriate level of monitoring work needed (if any) during the remainder of the operations phase. Monitoring would be conducted using the standard Region One Landbird Monitoring Protocol (USDA Forest Service 1998b).

2.5.7.4 Cultural Resource Mitigation

All mine and transmission line alternatives would require additional cultural resource inventory to satisfy requirements of Section 106 under the NHPA and 22-3, MCA. Additional survey would be conducted in all previously undisturbed areas where surface disturbance would occur in the alternative selected in the ROD. Such areas would include any surface disturbance required in mitigation plans described in Alternatives 3 or 4, such as instream structures for fisheries mitigation. The number of cultural resources that would require mitigation may increase pending

the result of these additional inventory efforts. The appropriate type of mitigation would depend on the nature of the cultural resource involved and would ultimately be determined during consultation between MMC, the KNF, and Montana SHPO. Any mitigation plan would be developed by MMC and approved by both the KNF and the Montana SHPO under a memorandum of agreement (MOA), and would include consulting Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho if affected cultural resources were prehistoric or of recent cultural significance.

Mitigation could include data recovery (excavation) of prehistoric archaeological sites, a Historic American Building Survey (HABS) for standing structures, or Historic American Engineering Record (HAER) for built resources such as mines, roads, and trails. For landscape-level resources such as the Libby Mining District, the USDI National Park Service's (NPS) Cultural Landscapes Program would be implemented. Mitigation also would include monitoring during ground disturbing activities when the subsurface spatial extent of the resource is unknown or because of the fragility of the resource and its proximity to the activity. Section 3.7.5, *Mitigation* discusses mitigation measures for known resources in the analysis area.

2.6 Alternative 4—Agency Mitigated Little Cherry Creek Impoundment Alternative

2.6.1 Issues Addressed

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. In Alternative 4, MMC would use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed permit and disturbance areas at the LAD Areas, as in Alternative 3 (Figure 37). In addition to these modifications from Alternative 3, MMC would modify the proposed Little Cherry Creek Tailings Impoundment Site disturbance areas to avoid RHCAs (Issue 3) and old growth (Issue 6) in the Little Cherry Creek drainage. Borrow areas would be reconfigured to maximize disturbance within the impoundment footprint, and to minimize disturbance of RHCAs (Issue 3), core grizzly bear habitat (Issue 5), and old growth (Issue 6). Waste rock would be stored temporarily within the impoundment footprint to address acid rock drainage and metal leaching (Issue 1) and water quality and quantity (Issue 2). The proposed permanent Little Cherry Creek Diversion Channel below the engineered upper section would be modified to adequately convey anticipated flows. At closure, surface water runoff would be directed toward the Little Cherry Creek Diversion Channel, and not Bear Creek, an important bull trout stream. The issues addressed by the modifications and mitigation measures are summarized in Table 28. The modifications and proposed mitigations that comprise Alternative 4 are described in the following sections. All other aspects of MMC's mine proposal would remain as described in Alternative 2. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 28. Response of Alternative 4 Modifications and Mitigations to Issues.

Key Issue	Mine Plan	Tailings Storage	Water Use and Manage-ment	Reclamation	Monitoring and Mitigation Plans
Issue 1-Acid Rock Drainage and Metal Leaching	✓		✓		
Issue 2-Water Quality and Quantity	✓	✓	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓		✓
Issue 4-Visual Resources	✓	✓		✓	
Issue 5-Threatened or Endangered Species	✓	✓		✓	✓
Issue 6-Wildlife	✓	✓		✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.	✓			✓	✓

2.6.2 Construction Phase

MMC would modify the proposed permit and disturbance areas to avoid RHCAs and old growth in the Little Cherry Creek drainage. Changes to MMC's proposed construction methods, such as soil handling, described for Alternative 3, would be implemented in Alternative 4. Other modifications specific to Alternative 4 are described in the following sections. As in Alternative 3, MMC would submit a final Plan of Operations after final design, including all monitoring and mitigation plans, to the KNF for approval. MMC would submit a final application for a modification of Operating Permit #00150, including all monitoring and mitigation plans, to the DEQ for approval.

2.6.2.1 Permit and Disturbance Areas

All permitted disturbance area boundaries would be marked in the field with fence posts and signed to limit potential disturbance outside permitted disturbance areas. Permit areas would total 3,245 acres and the total disturbance area would be 2,254 acres (Table 29).

2.6.2.2 Modified Little Cherry Creek Tailings Impoundment

MMC would modify the proposed permit and disturbance areas to avoid old growth, core grizzly bear habitat, and RHCAs in the Little Cherry Creek drainage (Figure 22). To the extent feasible, MMC would maximize borrow areas within the footprint of the Little Cherry Creek tailings impoundment footprint to avoid impacts to old growth in Borrow Areas B and C. Acceptable borrow on either side of Little Cherry Creek more than 200 feet from the upstream dam face would be used in Borrow Areas A and B. If suitable borrow were not available within the footprint of the impoundment, MMC would use Borrow Areas C and E, in that order. MMC would locate Borrow Area D south of the Little Cherry Creek impoundment between NFS roads

#278 and #6212 to avoid core grizzly bear habitat (Figure 22). As in Alternative 3, unsuitable materials would be stockpiled and backfilled into borrow areas outside the impoundment footprint in borrow areas C and E. Waste rock would be managed in the same manner as Alternative 3.

Table 29. Mine Surface Area Disturbance and Operating Permit Areas, Alternative 4.

Facility	Disturbance Area (acres)	Permit Area (acres)
Existing Libby Adit	22	219
Upper Libby Adit	1	1
Rock Lake Ventilation Adit	1	1
Libby Plant Site and Adits	**110**	**172**
Modified Little Cherry Creek Tailings Impoundment	**1,602**	**2,191**
Little Cherry Creek Impoundment and Seepage Collection Pond	628	
Borrow areas outside impoundment footprint	**252**	
Soil stockpiles	53	
Other potential disturbance (Diversion Channel, roads, storage areas)	**669**	
LAD Area 1	**260**	**277**
LAD Area 2	**123**	**196**
Access Roads[†]		
Bear Creek Road (NFS road #278 from U.S. 2 to Tailings Impoundment)	**79**	**10**
Tailings Impoundment to LAD Areas 1 and 2 (NFS roads 2317 and #4781 and new road to NFS road #278)	**30**	**97**
LAD Area to Libby Plant (NFS road #4781 and #6210)	**17**	**70**
Libby Plant Site to Libby Adit Site and Upper Libby Adit Site (NFS roads #6210 and #2316)	**9**	**11**
Total	**2,254**	**3,245**

[†]Disturbance area shown for roads excludes 33 feet of existing disturbance along roads.
Bolded values differ from Alternative 2.

Noranda conducted geotechnical investigations at the Little Cherry Creek Impoundment Site between 1988 and 1990. Noranda reported that bedrock is exposed in the Little Cherry Creek channel and bedrock extended 800 feet downstream of the proposed Seepage Collection Dam (Morrison-Knudsen Engineers, Inc. 1990). Ground water modeling conducted of the Little Cherry Creek Impoundment Site by MMC (Klohn Crippen 2005) and independently verified by the lead agencies (USDA Forest Service 2008a) assumed that the fractured bedrock strata in the Little Cherry Creek drainage is the primary aquifer for ground water flow at the site. In Alternative 4,

MMC would conduct additional geotechnical work near the Seepage Collection Dam during final design and site the dam lower in the drainage if technically feasible.

In Alternative 4, MMC would complete a hydraulic and hydrologic (H&H) analysis of the proposed diversion channel during final design, and submit it to the lead agencies and the Corps for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. The channel would begin at the outlet of the engineered channel and would be designed to have the following characteristics:

- A constructed floodplain and terrace that would allow passage of the 100-year flow volume
- A stream portion of the diversion corridor constructed to meet the 2-year flow event volume and approximate the cross-section, profile, and channel materials of similar sized watersheds found in the project area
- Establishment of fish habitat similar to that currently provided by Little Cherry Creek to the extent feasible with the anticipated lower flows

Several mitigation measures would be implemented along the channel to ensure that erosion and sedimentation resulting from heavy rainfall and from high flow events would be minimized. These measures would include:

- The channel and floodplain would be constructed during low flow periods in late summer or early fall
- Floodplain and channel banks would be seeded with an agencies-approved seed mix immediately following construction
- A temporary biodegradable erosion control fabric would be installed along the channel banks, where needed, and on the floodplain immediately following seeding
- Structures of natural materials, which could include boulders or rock/log weirs or vanes, may be installed to protect stream banks where needed
- Alders would be planted along the channel banks at and above bankfull elevation following placement of the erosion control fabric at a density similar to what is currently present along Little Cherry Creek
- Coarse woody debris would be placed along the channel banks to increase surface roughness to reduce flow velocities

Flow in the diversion channels would increase substantially during two periods, one during the construction period after the Diversion Dam was constructed and flow from upper Little Cherry Creek was diverted into the channel, and one after closure when runoff from the impoundment surface and South Saddle Dam flowed into the channel. MMC would complete habitat surveys in the diverted Little Cherry Creek every 2 years until the reclamation bond had been released. The survey would document distance, elevation, macrohabitat type, pool dimensions, large woody debris, substrate, valley slope and width, and riparian characteristics continuously along the entire length of the creek.

The agencies anticipate the channel would require long-term maintenance; MMC would fund a long-term maintenance account to pay for such maintenance. The decision regarding long-term maintenance funded would be made following closure and prior to bond release, after runoff from

the tailings impoundment flowed into the diversion channel. In Alternative 4, soil would be salvaged in two lifts at the Little Cherry Creek Diversion Channel. Soils salvaged from the Diversion Channel would be used as replaced soil on the created floodplain and stream banks of the lower diversion channels and possibly at other disturbances.

In Alternative 2, MMC would build temporary diversion ditches to control run-on within the impoundment site to minimize run-on into the tailings impoundment after Year 2 of operations. As the impoundment filled, new ditches would be excavated farther uphill. Because of the difficulty in routing the run-on into the Little Cherry Creek Diversion Channel, MMC in Alternative 4 would build a permanent diversion ditch between the North Saddle Dam and the Little Cherry Creek Diversion Channel, directing flow either into the Diversion Channel, or Bear Creek (Figure 38). The ditch would be integrated into the surface water management plan of the tailings impoundment at final closure.

The tailings facility design would be finalized as additional site information is obtained during the final design process. In final design, guidelines from the Idaho Administrative Code Safety of Dam Rules (IDAPA 37.03.06, Rule 40.14.d.i]), and the California Department of Water Resources Division of Safety of Dams guidelines for seismic stability would be included in the design criteria for the tailings impoundment. Technical review of the final design would be the same as Alternative 3.

2.6.3 Operations Phase

2.6.3.1 Water Use and Management

2.6.3.1.1 Project Water Requirements

The water balance in Alternative 4 would have the same components as MMC's projected water balance in Alternative 2. If the steady-state inflows were 450 gpm as predicted by the ground water model, MMC would need additional water for the mill. The make-up water well field would be in the tailings impoundment area, along NFS road #1408 west of Libby Creek (Figure 38). The limitations on make-up water withdrawals would be the same as Alternative 3. Discharges of up to 198 gpm at the LAD Areas were used for purposes of analysis; discharge volumes may vary and would be based on compliance with water quality standards. Based on the lead agencies' analysis, MMC should have adequate capacity to manage excess water volumes at the existing Libby Adit Water Treatment Plant and outfalls or at the two LAD Areas. If additional capacity were needed, MMC would implement the measures discussed in Alternative 2 to reduce inflows or manage excess water.

2.6.3.1.2 Wastewater Discharges

In Alternative 4, MMC would maintain the three outfalls at the Libby Adit Site and would seek authorization for additional outfalls. Potential discharges associated with Alternative 4 would be the same as Alternative 2 at the Little Cherry Creek Tailings Impoundment (Figure 15) and the same as Alternative 3 at the LAD Areas 1 and 2 (Figure 28). Potential discharges associated with Alternative 4 include:

- Seepage or percolation to ground water beneath LAD Areas 1 and 2
- Surface water runoff from LAD Areas 1 and 2

- Seepage or percolation to ground water beneath the Little Cherry Creek Tailings Impoundment

2.6.3.2 Transportation and Access

The following sections describe road use and public access along the main access road (Bear Creek Road (NFS road #278) and each proposed permit area. With the exception of the Bear Creek Road in the impoundment permit area, all open roads would be gated and limited to mine traffic only. Non-motorized public access would be restricted within each permit area by signage at the permit area boundary. Table 30 lists those roads with a change in road status in Alternative 4; these roads are shown on Figure 39.

2.6.3.2.1 Bear Creek Road (NFS Road #278)

In Alternative 4, MMC would use the same roads as Alternative 2 for main access during the Libby Adit evaluation program and during operations. MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. Other mitigation measures described in Alternative 3 would be implemented.

Reconstruction of the Bear Creek Road (NFS road #278), from U.S. 2 to the Bear Creek bridge, Bear Creek bridge replacement, and culvert replacement on NFS road #231 (Libby Creek Road) would be the same as Alternative 3. The public and mine haul traffic would use a segment of the Bear Creek Road from the tailings impoundment permit boundary to the Libby Plant Site Access Road. Because of the joint use, the road would be widened to accommodate haul truck traffic and another lane of public traffic. The joint-use road segments would be widened to widths recommended by the Mine Safety and Health Administration (Mine Safety and Health Administration 1999). For a 16-foot wide haul vehicle, the road width would be 56 feet wide.

MMC would surface the existing Bear Creek Road (NFS road #278) from the new Libby Plant Access Road to the Libby Creek Road (NFS road #231) with 6 inches of gravel 16 feet wide (Figure 39). This surfacing would ensure the safe transition from the improved section north of the new Libby Plant Access Road and the unimproved section to the Libby Creek Road.

2.6.3.2.2 Little Cherry Creek Tailings Impoundment Area

Road use and access in the tailings impoundment area in Alternative 4 would be very similar to Alternative 2. All roads in the operating permit area would be closed to all public access. Little Cherry Loop Road (NFS road #6212) would be gated during operations and used for mine traffic only (Figure 39). The gates would be near the intersection with the Bear Creek Road on the north end and the tailings impoundment permit area boundary on the south end. NFS road #6212 would remain open to motorized access south of the proposed permit area boundary to the junction with Bear Creek Road. At the end of operations, gates on these roads would be removed and would be reopened to motorized access. A segment of the Little Cherry Loop Road (NFS road #6212) would be covered by the tailings impoundment and would not provide a loop between the Bear Creek Road. With the exception the Cherry Ridge Road (NFS road #6201), other currently gated or barriered roads proposed for use in Alternative 2 in the tailings impoundment area would be used in Alternative 4.

Table 30. Proposed Change in Road Status, Alternative 4.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
2317B	Poorman Creek B	LAD Area 2	No closure order, impassable	0.8	Gated, mine traffic only
278X	Bear Creek X	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.0	Gated, mine traffic only
4781	Ramsey Creek	LAD Area 2	Open	0.3	Barriered year-long to motor vehicles
4781	Ramsey Creek	LAD Area 1 up Ramsey Creek	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	3.2	Barriered year-long to motor vehicles
5170	Poorman Creek Unit	LAD Area 2	Open	0.2	Gated, mine traffic only
5186	Ramsey Creek Bottom	LAD Area 2	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.5	Gated, mine traffic only
14403	Lower Ramsey	Libby Plant Site	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Gated, mine traffic only
1408	Libby Creek Bottom	Tailings Impoundment	No closure order, impassable	0.5	Gated, mine traffic only
5181A	Little Cherry Loop H Cowpath A	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.2	Barriered
5182	Little Cherry Bear Creek	Tailings Impoundment	Open	1.6	Gated, mine traffic only
5183	Little Cherry View	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.5	Gated, mine traffic only
6212	Little Cherry Loop	Tailings Impoundment	Open	1.1	Gated, mine traffic only
6212H	Little Cherry Loop H	Tailings Impoundment	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Barriered
6701	South Ramsey Creek	Upper Ramsey Creek	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.4	Barriered year-long to motor vehicles
8838	Little Cherry MS 10377 8838	Tailings Impoundment	Open	0.2	Gated, mine traffic only

2.6.3.2.3 LAD Areas 1 and 2, Libby Plant Site, Libby Adit, and Upper Libby Adit

Access and road use in the LAD Areas, Libby Plant Site, Libby Adit, and Upper Libby Adit in Alternative 4 would be the same as Alternative 3 (Figure 39 and Table 30). A segment of NFS road #4781 east of LAD Area 1 and NFS road #2316 near the Libby Adit Site would be widened to 56 feet to accommodate public/mine haul traffic.

2.6.3.2.4 Ramsey Creek Drainage

Access and road use on NFS road #4781 up Ramsey Creek and NFS road #6701 would change from gated to barriered to provide grizzly bear mitigation.

2.6.4 Reclamation Phase

2.6.4.1 Post-Mining Topography of Project Facilities

Short- and long-term reclamation objectives would remain the same as for Alternative 2. These objectives would be achieved through interim and final reclamation of all disturbed sites as described for Alternative 2, with additional mitigation described for Alternative 3 and implementing all erosion- and sediment-control measures described for Alternative 2. The modifications described in section 2.5.5.2, *Revegetation* would be implemented for Alternative 4.

2.6.4.1.1 Little Cherry Creek Tailings Impoundment

Prior to closure, MMC would manage tailings deposition and beaches to ensure that the final tailings surface would slope southwest toward the Diversion Dam (Figure 40). A spillway in the dam would convey surface flow for the final impoundment surface to a diversion ditch and then to the Diversion Channel. Minor modifications to the design of the Diversion Channel, Diversion Dam, and North Saddle Dam would be completed during final design to incorporate this modification.

As in Alternative 3, MMC would survey tailings settlement at closure on a 100-foot by 100-foot grid to document settlement. The area would be resurveyed after borrow material used for fill was placed to create final reclamation gradients, and again after soil placement to ensure runoff gradients were achieved and soil thicknesses were met. Rocky borrow and geotextile would be needed for construction equipment to work on the tailings surface. In Alternative 2, MMC would place riprap on the dam crest and uppermost part of the dam face to minimize potential gully formation at the tailings dam crest. In Alternative 4, MMC would use rocky borrow from within the disturbance area to provide erosion protection. Borrow material volumes would be determined during final design.

MMC would develop a design to recontour faces of the tailings impoundment dams to more closely blend with the surrounding landscape. Sand deposition would be varied during final cycloning and placement of sand on the dams. This design would incorporate additional rocky borrow at selected locations on the dam face and use benches in some locations. Islands of trees and shrubs would be planted in the rocky areas. The seed mixture on the dam face would vary to reduce uniformity of the revegetated dam.

2.6.4.1.2 Roads

Reclamation of the Bear Creek Road, new roads, and all new bridges used in Alternative 4 would be the same as Alternative 2, except for the following changes. In Alternative 4, the two gates on the Little Cherry Creek Loop Road (NFS road #6212) (near the intersection of the Bear Creek

Road on the north side and at the permit area boundary on the south side) would remain in place. Motorized access on Little Cherry Creek Loop Road (NFS road #6212), NFS road #5182, and NFS road #8838 would be restricted to administrative use. All currently gated or barriered roads used in Alternative 4 would be decommissioned by using a variety of treatment methods to achieve desired conditions for other resources.

2.6.5 Operational and Post-Operational Monitoring Programs

Operational and post-operational monitoring programs described for Alternative 3 would be implemented for Alternative 4. Plans not modified in Alternative 3 would be the same as Alternative 2. A number of springs and wetlands occur downstream of the proposed Little Cherry Creek Tailings Impoundment. The GDE inventory and monitoring program would be revised slightly from that proposed in Alternative 3.

2.6.5.1 Ground Water Dependent Ecosystem Inventory and Monitoring

2.6.5.1.1 Spring and Seep Monitoring

A GDE inventory of an area overlying the mine area and subsequent monitoring of GDEs would be completed in Alternative 4, as described in Alternative 3. In addition, flow from springs SP-02, SP-10, S-12, SP-14, SP-15, and SP-29 (Figure 41) would be measured twice in Alternative 4, once in early June when the area was initially accessible, and once between mid-August and mid-September 1 year before construction began. (Springs SP-02 and SP-15 would not be monitored if they were covered by impoundment facilities.) Samples from these springs would be collected 1 year before construction began and analyzed for total dissolved solids, nitrate + nitrite, sulfate, antimony, and manganese. Sampling would be repeated every 2 years until tailings disposal ceased. At each spring, a vegetation survey would be completed 1 year before construction began; the survey and establishment of “trigger plants” would be the same as Alternative 3.

2.6.5.1.2 Monitoring of Wetlands Downstream of Tailings Impoundment

In Alternative 2, MMC would monitor unspecified wetlands downstream of the tailings impoundment annually for the first 5 years of mine operation. In Alternative 4, MMC would monitor three wetlands if not filled by project activities: LCC-24, LCC-25, and LCC-39 (Figure 41). MMC would use the procedures established for monitoring of wetland mitigation sites described in Alternative 3 to assess vegetation characteristics and establish “trigger” species. Trigger species would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring. Samples from any standing water in these three wetlands would be collected in mid-summer 1 year before construction began and analyzed for total dissolved solids, nitrate + nitrite, sulfate, antimony, and manganese. Sampling would be repeated in mid-summer every 2 years until tailings disposal ceased.

2.6.6 Mitigation Plans

In Alternative 4, the Wetland Mitigation Plan and the Fisheries Mitigation Plan would differ from that proposed in Alternative 2. The proposed plans for wetlands and fisheries are discussed below. The same general components in the Wildlife Mitigation Plan of Alternative 3 would be incorporated into Alternative 4. The Hard Rock Mining Impact Plan would be the same as Alternative 2.

2.6.6.1 Wetland Mitigation

2.6.6.1.1 Proposed Sites

In Alternative 2, MMC proposed to mitigate affected forested and herbaceous wetlands at a 2:1 ratio, and herbaceous/shrub wetlands and waters of the U.S. at a 1:1 ratio. MMC's proposed mitigation sites are two sites in the Little Cherry Creek drainage, the Little Cherry Creek Diversion Channel, three sites between Little Cherry and Poorman creeks (in Alternative 3, the Poorman Impoundment Site), one site east of the LAD Area 1, and one site at the Libby Creek Recreational Gold Panning Area.

In Alternative 4, possible wetland mitigation sites would include 2.2 acres at the North Little Cherry Creek site; 27.1 acres at the South Poorman, North Poorman, and Poorman Weather Station sites; and 6.7 acres at the Ramsey Creek site (Figure 34). According to MMC, the Poorman Weather Station is not within an area of existing wetlands and has no well-defined drainage. Wetlands created at this site may not be jurisdictional if the site did not have a hydrologic connection to a jurisdictional water. If the wetlands adjacent to the proposed mitigation sites were not jurisdictional wetlands, additional mitigation sites would be developed. One year of ground water monitoring at the mitigation sites, as proposed in Alternative 3, would be implemented in Alternative 4. According to MMC, the Ramsey Creek mitigation site is part of an existing man-made wetland area. MMC would conduct a wetland delineation of the proposed area during final design to ensure the wetland is jurisdictional. If the site were appropriate for mitigation of effects on jurisdictional wetlands, the site would be expanded by spreading out streamflow that would provide hydrologic support.

In Alternative 4, the site at Little Cherry Creek not specifically identified by MMC in Alternative 2 would not be used. At this site, MMC would use ground water collected from beneath the tailings impoundment to create and maintain wetlands. Ground water beneath the tailings impoundment may be mixed with tailings water, and contain elevated nutrients and metal concentrations. Use of ground water beneath the tailings impoundment would not provide hydrologic support after operations cease. The mitigation site at the Libby Creek Recreational Gold Panning Area was not part of the 1993 404 permit. Because of the proximity to high public use at the Recreational Gold Panning Area, it would not be used in Alternative 4.

The Corps would be responsible for developing final mitigation ratios for jurisdictional wetlands, depending on the function and values of the affected wetlands. The minimum ratio for wetland restoration (re-establishment and rehabilitation) is 1.5 acres restored to 1 acre impacted; the minimum ration for establishment is 2 acres established to 1 acre impacted (Corps 2005). Insufficient mitigation sites have been identified to achieve the Corps' minimum ratios, and additional mitigation sites would be necessary if this alternative were permitted.

2.6.6.1.2 Monitoring of Wetland Mitigation Sites

Monitoring of mitigation sites would be the same as Alternative 3, except for wetlands downgradient of the tailings impoundment (see section 2.5.6.2, *Ground Water Dependent Ecosystem Monitoring*).

2.6.6.2 Fisheries Mitigation

2.6.6.2.1 Fish Loss in Little Cherry Creek Diversion

In Alternative 2, MMC proposed to implement the mitigation developed in 1993 to mitigate the loss of recreational fishing opportunity and the loss of fisheries production in Little Cherry Creek. In Alternative 4, the same mitigation described in section 2.4.6.2, *Fisheries Mitigation* would be implemented, with the following exceptions.

A sediment source inventory in the Libby Creek watershed was one of the menu of possible mitigation projects in Alternative 2. In Alternatives 3 and 4, MMC would conduct an inventory and implement sediment reduction measures in Ramsey, Poorman, and Upper Libby creeks. This mitigation would be required, and not be optional.

Stocking of Ramsey, Standard, or Snowshoe creeks with a trout species of concern was one of the menu of possible mitigation projects in Alternative 2. In Alternative 4, the trout species of concern would be either westslope cutthroat trout or redband trout.

In Alternative 2, a survey and rehabilitation of the fish population in the Kilbrennan Lake was one of the possible mitigation projects. This project has been completed. In Alternative 4, the same project would be completed at Howard Lake.

2.6.6.2.2 Bull Trout Critical Habitat and Sediment

The proposed mitigation for bull trout critical habitat in Rock Creek, East Fork Bull River, and Libby Creek in Alternative 4 would be the same as Alternative 3. The mitigation for increased sediment in Libby Creek in Alternative 4 would be the same as Alternative 3. This mitigation is discussed in section 2.5.7.2, *Fisheries Mitigation*.

2.7 Alternative A—No Transmission Line

In this alternative, MMC would not build a 230-kV transmission line to provide power. The BPA would not tap the Noxon-Libby 230-kV transmission line nor would it build the Sedlak Park Substation. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the transmission line. The DEQ's approval of the Montanore Project, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the permitting lead agencies could select the No Action Alternative, or deny the transmission line certificate, are described in section 1.6, *Agency Roles, Responsibilities, and Decisions*.

2.8 Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alignment Alternative)

The Ramsey Plant Site's electrical service would be 230-kV, 3-phase, 60-cycle, provided by a new, overhead transmission line. MMC would be responsible for funding construction of the transmission line, substation, and loop line that would connect the substation to the Noxon-Libby 230-kV transmission line. MMC's proposed transmission line alignment would be in the watersheds of the Fisher River, Miller Creek, an unnamed tributary to Miller Creek, Midas Creek, Libby Creek, and Ramsey Creek (Figure 42). The proposed alignment would head northwest

from the substation for about 1 mile paralleling U.S. 2, and then follow the Fisher River and U.S. 2 north 3.3 miles. The alignment would then turn west and generally follow the Miller Creek drainage for 2.5 miles, and then turn northwest and traverse up a tributary to Miller Creek. The alignment would then cross into the upper Midas Creek drainage, and then down to Libby Creek. The alignment would cross the low ridge between Libby Creek and Ramsey Creek, and then generally follow Ramsey Creek to the Ramsey Plant Site. The maximum annual energy consumed by the project is estimated at 406,000 megawatts, using a peak demand of 50 megawatts.

The characteristics of MMC's proposed North Miller Creek Alignment Alternative and the lead agencies' three other transmission line alignment alternatives are summarized in Table 31. A comparison of the mitigation and modifications the agencies made to the alternatives' to MMC's proposal is presented in Table 32. MMC's proposed alignment (Alternative B) would end at a substation at the Ramsey Plant Site; the lead agencies' alternatives (Alternatives C, D, and E) would end at a substation at the Libby Plant Site. Alternative B, and the other three transmission line alternatives, would require a KFP amendment. This required amendment is discussed in section 2.12, *Forest Plan Amendment.*

Estimated transmission line construction costs range from $7.3 million for Alternative B to $5.4 million for Alternative C. High steel costs would make the steel monopoles proposed in Alternative B considerably more expensive than the wooden H-frame structures proposed in the other alternatives. The lower cost of wooden H-frame structures in Alternatives C, D, and E would offset the cost of helicopters to set structures and clear timber in these alternatives. Estimated mitigation costs range from $14.3 million for Alternative C to $15.0 million for Alternative E. Cost estimates are based on preliminary design and material costs in early 2008.

2.8.1 Substation Equipment and Location

Two substations would be required. One substation would be used to tap the Noxon-Libby 230-kV transmission line and supply power to the mine site over a new 230-kV transmission line. BPA's proposed Sedlak Park Substation Site at the Noxon-Libby 230-kV transmission line is in an area known locally as Sedlak Park, 30 miles southeast of Libby on U.S. 2 (Figure 43). At the Ramsey Plant Site, a second, 150-foot by 300-foot substation would be built (Figure 5) to distribute electricity through lower voltage lines to equipment in various locations at the Ramsey Plant Site, the Libby Adit Site, the Little Cherry Creek Tailings Impoundment site, and within the underground mine.

The BPA would design, construct, own, operate, and maintain the Sedlak Park Substation and loop line. The BPA is prohibited by law from providing power directly to a user; Flathead Electrical Cooperative would be the retailer of power to the mine project. MMC would be responsible for funding construction of the transmission line, substation, and loop line that would connect the substation to the Noxon-Libby 230-kV transmission line. The proposed location of Sedlak Park Substation is common to the four transmission line alternatives. Sedlak Park Substation construction would require disturbing 2 acres. The substation would be near U.S. 2 and require a short access road from U.S. 2 (Figure 43). The access road from U.S. 2 would be designed and constructed to MDT standards.

Table 31. Characteristics of Transmission Line Alignment Alternatives.

Characteristic	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Length (miles)[†]				
Steel monopole	16.4	0.0	0.0	1.4
Wooden H-frame	0.0	13.4	14.1	13.5
Total	16.4	13.4	14.1	14.9
Number of structures[‡]	108	80	95	101
Approximate average span length (ft)	800	885	785	780
Helicopter use				
Structure placement	At contractor's discretion	21 structures, primarily in upper unamed tributary of Miller Creek and Midas Creek	20 structures, primarily in upper Miller Creek	23 structures, primarily along West Fisher Creek
Vegetation clearing	At contractor's discretion	At selected locations; see Figure 45	At selected locations; see Figure 45	At selected locations; see Figure 45
Line stringing	At contractor's discretion	Yes, entire line	Yes, entire line	Yes, entire line
Annual inspection	Yes	Yes	Yes	Yes
Estimated cost in millions of 2008 $[¶]				
Construction	$7.3	$5.4	$5.8	$6.0
Mitigation	$14.9	$14.5	$14.5	$15.0

[†]Length is based on line termination at the Ramsey Plant Site in Alternative B and the Libby Plant Site in the other three alternatives.
[‡]Number and location of structures based on preliminary design and may change during final design. The lead agencies' analysis of MMC's preliminary design and structure locations indicates additional structures and access may be needed to avoid long spans.
[¶]Estimated cost used reasonable assumptions regarding costs of construction materials, clearing, land acquisition, and engineering. Final cost could vary from those shown. Estimated construction cost by HDR Engineering, Inc. 2008; estimated construction cost by ERO Resources Corp. 2008.

Table 32. Comparison of Mitigation in Transmission Line Alternatives.

Feature/Resource	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
New Access Road Management				
New roads on National Forest System Lands	Soiled and reseeded after construction; used as necessary for maintenance; decommissioned at closure	Placed in intermittent stored service after construction; used as necessary for maintenance; decommissioned at closure	Same as Alternative C	Same as Alternative C
New roads on Plum Creek lands	Soiled and reseeded after construction; gated and used as necessary for maintenance	Same as Alternative B	Same as Alternative B	Same as Alternative B
New roads on other private land	None	None	Soiled and reseeded after construction; gated and used as necessary for maintenance	Same as Alternative D
Vegetation Management				
Right of Way (ROW) Width	ROW width of 100 feet; danger trees outside the ROW would be removed as necessary; analysis assumed 150-foot clearing width	ROW width of 150 feet; danger trees outside the ROW would be removed as necessary; analysis assumed 200-foot clearing width	Same as Alternative C	Same as Alternative C except for short section of monopoles with a 100-foot ROW
Vegetation Clearing	Vegetaton removed	Prepare and implement Vegetation Clearing and Removal Plan; heavy equipment use in RHCAs minimized	Same as Alternative C	Same as Alternative C
Helicopter Use for Vegetation Clearing	At contractor’s discretion	In areas adjacent to core grizzly bear habitat	Same as Alternative C	Same as Alternative C

Feature/Resource	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Seed Mixes	Interim and permanent seed mixes with native and introduced species	Permanent seed mix with native species only, if commercially available	Same as Alternative C	Same as Alternative C
Wildlife see Table 4 for additional mitigation for the mine				
Old Growth	Not specified	Designate 222 acres of effective or replacement old growth on National Forest System lands	Designate 247 acres of effective or replacement old growth on National Forest System lands	Designate 247 acres of effective or replacement old growth on National Forest System lands
Snags (Cavity Habitat)	Not specified	Leave snags in clearing area, unless required to be removed for safety reasons	Same as Alternative C	Same as Alternative C
Down Wood Habitat	Not specified	Leave up to 30 tons per acre of coarse woody debris within clearing area	Same as Alternative C	Same as Alternative C
Big Game Security	Not specified	See proposed road access changes in Table 4. No transmission line construction in elk, white-tailed deer, or moose winter range between December 1 and April 30 unless approved by the agencies.	Same as Alternative C	Same as Alternative C

Feature/Resource	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Bald Eagle	Not specified	Fund or conduct surveys to locate active nests in appropriate habitat or not remove vegetation in the nesting season; follow Montana Bald Eagle Management Plan. Construct transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006)	Same as Alternative C	Same as Alternative C
Forest Sensitive Birds and State Bird Species of Concern	Not specified	Complete surveys to locate active nests in appropriate habitat or not remove vegetation in the nesting season	Same as Alternative C	Same as Alternative C
Western Toad	Not specified	Retain shrub habitat in wetlands and riparian areas	Same as Alternative C	Same as Alternative C

Feature/Resource	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Migratory Birds	Not specified	Fund or conduct monitoring of landbird populations annually on two, standard Region One monitoring transects within the Crazy and Silverfish PSUs. Construct transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006)	Same as Alternative C	Same as Alternative C
Grizzly Bear				
Road and Trail Access changes	See proposed road access changes in Table 4	See proposed road access changes in Table 4	Same as Alternative C	Same as Alternative C
Land Acquisition for Physical Disturbance	Acquire 79 acres; part of land acquisition described in Table 4	Secure or protect replacement grizzly bear habitat of 24 acres of private lands in the Cabinet-Yaak Ecosystem	Secure or protect replacement grizzly bear habitat of 27 acres of private lands in the Cabinet-Yaak Ecosystem	Secure or protect replacement grizzly bear habitat of 28 acres of private lands in the Cabinet-Yaak Ecosystem
Habitat Enhancement for Reduced Habitat Effectiveness	Not specified	Enhance grizzly bear habitat on 11,324 acres of private lands in the Cabinet-Yaak Ecosystem	Enhance grizzly bear habitat on 12,218 acres of private lands in the Cabinet-Yaak Ecosystem	Enhance grizzly bear habitat on 14,851 acres of private lands in the Cabinet-Yaak Ecosystem

The substation sites would be fenced. The area surrounding the substation would be graveled and kept free of vegetation. No water would be required at the Sedlak Park Substation site, and toilet facilities would be self-contained. The Sedlak Park Substation would be designed to exclusively serve the mine. No additional lines have been proposed to enter or leave the Sedlak Park Substation.

2.8.2 Line and Road Construction Methods

The construction of the proposed transmission line would follow the sequence of: 1) centerline surveyed and staked; 2) ROW cleared and access roads built; 3) work areas cleared and leveled as needed; 4) foundations installed, and transmission line structures erected and installed; 5) ground wire, conductors, and ground rods installed, and 6) the site would be cleaned up and reclaimed.

2.8.2.1 Surveying

Construction survey work would consist of establishing a centerline location, specific pole locations, ROW boundaries, work area boundaries, and access roads to work areas. The specified right of way boundaries, work areas, access roads, and other features would be marked with painted laths or flags. Markers would be maintained until final cleanup and/or reclamation was completed, after which they would be removed.

2.8.2.2 Access Road Construction and Use

Existing roads would be used for construction access where possible and new roads or spurs would be built only where necessary (Figure 42). New roads would be 12 feet wide and cleared of all trees and shrubs. In the agencies' analysis in Chapter 3, total roadway width, including cuts and fills, was assumed to be 25 feet. Wood refuse and cleared shrubs would be placed on the downhill edge of the road for erosion control. A road within the right-of-way would be required for line stringing operations across side slopes greater than 10 percent. MMC anticipates that no drainage would be provided for the new roads, but would follow the agencies' guidance if installation of culverts were required. No motorized activity associated with transmission line construction would occur from April 1 to June 15 within bear habitat in the Miller Creek and Midas Creek drainages. Construction would not occur during the winter in big-game winter range areas. Estimated access road lengths required for each alternative are shown in Table 33. The effects of road use and construction are discussed in sections 3.14, *Land Use;* 3.21, *Vegetation;* and 3.24, *Wildlife Resources.*

Where possible, roads currently open year-round would be used for construction access. Roads currently closed either seasonally or year-round would only be opened for construction access where necessary. Where seasonally closed roads would be used, efforts would be made to minimize their use during the periods when these roads would otherwise be closed. Alternative B would require the use of roads currently closed with a barrier with no administrative use. Table 34 lists those roads with a change in road status in Alternative B.

Roads opened or constructed for transmission line access on National Forest System lands would be closed after the transmission line was built. The road surface would be reseeded as an interim reclamation activity designed to stabilize the surface. Where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded. The prism of new roads would remain during mine operations. Management of newly constructed roads on Plum Creek land would depend on the easement agreement between Plum Creek and MMC. For purposes of

analysis, the lead agencies assumed newly constructed roads on Plum Creek land would be gated after line construction to allow Plum Creek access.

Table 33. Miles of Open, Closed, and New Access Roads Required for Transmission Line Construction.

Road Type	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Open road	20.3	22.7	19.7	12.0
Closed road	11.8	2.8	1.7	10.3
Extensive upgrade required	0.3	0.0	0.0	0.7
Other closed roads	11.5	2.8	1.7	9.6
New road	9.9	3.0	3.3	3.5
Total	42.0	28.5	24.7	25.8

Source: GIS analysis by ERO Resources Corp. using MMC and HDR Engineering data.

Table 34. Proposed Change in Road Status, Alternative B.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
4773	Howard Midas Creek	East of Howard Lake	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	1.1	Gated, construction traffic only
4777	Lower Midas - Howard Lk	North of Howard Lake	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.9	Gated, construction traffic only
4778	Midas Howard Creek	NE of Howard Lake	Barriered year-long to motor vehicles, including snow vehicles	0.9	Gated, construction traffic only
4778P	Midas Howard Creek P	NE of Howard Lake	Barriered year-long to motor vehicles, including snow vehicles	0.3	Gated, construction traffic only
14403	Lower Ramsey	Between Libby and Ramsey creeks	Barriered year-long to motor vehicles, open to snow vehicles December 1 through April 30	0.5	Gated, construction traffic only

Improvement of existing roads would be required in some areas to allow access of construction equipment into the transmission line corridor. Upgrades could include widening, lengthening of culverts, placing fill on or near stream banks, clearing, and regrading. Final design plans detailing the location of work areas and new and existing access roads would be submitted to the lead agencies for approval prior to construction.

MMC identified four possible stream crossing methods in constructing and upgrading roads: fords, culverts, arches, and bridges. MMC anticipates that culverts would be the most commonly used crossing method. BMPs outlined in "Water Quality BMPs for Montana Forests" (Logan 2001) would be followed. Erosion-control BMPs, such as the installation of water bars and dips would be implemented during construction and improvement of access roads. Special considerations could occur in the design and installation of culverts in waters that contain fish or support fisheries habitat. Based on a preliminary design, MMC anticipates requiring new stream crossings of new access roads at six locations: five in an unnamed tributary of Miller Creek, and one in Ramsey Creek. Additional stream crossings may be needed during timber clearing, and line stringing, if a helicopter were not used. Disturbance on active floodplains would be minimized to reduce sedimentation of streams during annual runoff. Construction activities would be restricted or curtailed during heavy rains or high winds to prevent erosion and soil loss. All transmission line alternatives would need to comply with proposed Environmental Specifications for the 230-kV transmission line (Appendix D).

2.8.2.3 Vegetation Clearing

The BPA would clear all trees at the Sedlak Park Substation Site, which would include the 2-acre substation and short access road from U.S. to the substation. Trees within the up to 300-foot right-of-way of the loop line also would be cleared. The BPA would conduct a noxious weed survey at the proposed Sedlak Park Substation Site before and after construction of the substation. It also would revegetate all disturbed areas outside of the access road prism and substation yard.

For the new 230-kV transmission line to the mine, most construction activity would be contained in the 100-foot right-of-way for steel monopole structures (Figure 44) with major exceptions being access road construction and conductor pulling and stringing. General right-of-way clearing would be governed by safety, reliability, environmental, and cost considerations. A 100-foot right-of-way would be cleared as necessary and additional tree clearing outside the 100-foot right-of-way would be necessary to prevent trees from falling into the line, or fires from flashovers where trees were too close to the conductor. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 150 feet of clearing along the entire alignment (Figure 44). Some areas within the 150-foot clearing area would not require clearing, such high spans across valleys. Actual acreage cleared would be less and would depend on tree height, slope and line clearance above the ground. Clearing would produce a "feathered" edge on the right-of-way clearing, with the width of right-of-way clearing varying along the line. Trees within the right-of-way would be removed to provide a minimum of 18 feet clearance between the vegetation and the conductor. Trees that would extend within 18 feet of the conductors within 5 years also would be removed. Other trees on or off the right-of-way that could fall into the line would be removed. In some areas, such as steep drainages, trees beneath the line would not be cleared if there were sufficient clearance between the line and the tree. Merchantable timber would be measured, purchased from the KNF, and then salvaged from the right-of-way; cleared smaller trees and brush would be burned or chipped. Non-merchantable trees and slash would be piled into windrows (using a brush blade to minimize soil accumulation) and burned. MMC did

not specify the type of vegetation clearing that would be used. For analysis purposes, the lead agencies assumed all vegetation clearing would be completed conventionally without the use of a helicopter.

2.8.2.4 Foundation Installation

Excavations for foundations would be made with power auger equipment. Where the soil permits, a vehicle-mounted power auger would be used. The foundation excavation and installation requires equipment access to the foundation sites. If rocky areas were encountered, foundations may require blasting. The foundation excavation and installation would require access to the site by a power auger or drill, a crane, material trucks, and ready-mix trucks. Concrete for use in constructing foundations would be obtained from commercial sources or from a remote batch plant on private land, depending on contractor needs.

Foundation holes left open or unguarded would be covered and/or fenced where practical to protect the public and wildlife. Soil removed from foundation holes would be stockpiled on the work area and used to backfill holes. All remaining soil not needed for backfilling would be spread on the work area. Concrete trucks would wash their chute debris into a depression in the permanent disturbance area at the pole site and soil from the foundation excavation would be used to cover the chute debris.

Where bedrock was encountered while excavating structure holes, a rock drill and compressor would be used to drill the rock. A hole would be blasted using explosives. Blasting would not expand the area needed for operations around the hole, but would increase the amount and duration of associated construction activity. It also would slightly affect the sequence and schedule of operations around those holes, extending the amount of time that the structures remain at the site before they can be set.

2.8.2.5 Structure Installation

MMC would use steel monopole structures a maximum of 95 feet high along the 100-foot right-of-way (Figure 44; Table 35). The distance between structures would vary from less than 200 feet to more than 2,000 feet, depending on the alignment selected and terrain crossed (Figure 42; Table 35). The lead agencies' analysis of MMC's preliminary design and structure locations indicates additional structures and access may be needed to avoid long spans and to achieve the proposed structure height. The cor-ten steel structures would be built to provide low reflectivity and long life. Cor-ten steel develops a stable rust-like appearance if exposed to the weather for several years. Tree clearing also would vary depending on span length and tree and structure height. MMC would work with the lead agencies to optimize structure height and span length to minimize concerns over tree clearing and visual considerations along any approved alignment and centerline.

Ground disturbance necessary for some pulling and tensioning sites may extend up to 100 feet beyond the right-of-way boundary where the line makes an angle. These sites usually require an area up to 40 feet by 150 feet. The proposed alignment would require 11 of these sites.

Table 35. Comparison of H-frame and Monopole Structures.

Design Element	H-Frame	Monopole
Right-of-Way Width (ft)	150	100
Estimated Clearing Width (ft)	200	150
Peak current loading (amps)	125	125
Nominal Voltage (volts)	230,000 (230-kV)	230,000 (230-kV)
Conductor Size	795 kcmil Drake	795 kcmil Drake
Conductor Type	ACSR	ACSR
Overhead Ground Wire (Approximate)	1 3/8-inch-dia galv and 1 Optical ground wire	Optical ground wire (diameter of <0.433 inches)
Electric field at edge of right-of-way at 3 ft above ground level (kV/m)	0.52	0.62
Magnetic field at edge of right-of-way (mG)	3.2	1-conductor side: 4.0 2-conductor side: 4.2
Typical Structure Height above Ground (ft)	74.5	83.5[†]
Minimum Ground Clearance of Conductor (ft at 212º F)[‡]	25	25
Typical Structure Base Dimensions	2 poles, 2 foot x 2 foot	1 pole, 17.33 inch diameter
Total land temporarily disturbed for conductor reel and pole storage yards (acres)	Similar to monopole	Up to 3.5

[†]Additional structures and access may be needed to avoid long spans and to achieve the proposed structure height.
[‡]Minimum ground clearance used in developing preliminary plan and profiles; actual ground clearance would vary.
ACSR = aluminum core steel reinforced; Kcmil = 1,000 circular mils; kV = Kilovolts;
kV / m = kilovolts per meter; mG = milligauss
Source: MMI 2005b; Power Engineers 2005; HDR Engineering 2007.

Structure construction activity is expected to occur within 30 feet of the holes where the structures would be installed. Activities conducted outside the 30-foot radius would include pole assembly, framing conductor supports and establishing an operating location for the crane. The optimal crane operating conditions require that the crane be as close to the hole as possible but because of uneven terrain at certain sites, cribbing with timbers under the crane outriggers would be necessary to level the crane. The need for the crane to be outside of the 30-foot radius would probably be the exception. Temporary construction yards may be necessary and would be located on existing disturbed areas or other areas on private lands along the line alignment.

2.8.2.6 Line Stringing

Once structures were in place, a pilot line would be pulled (strung) from structure to structure and threaded through the stringing sheaves on each structure. A larger diameter, stronger line would then be attached to the pilot line. This is called the pulling line, and one pulling line is connected to a conductor or overhead ground wire. Each conductor or ground wire is then pulled through the sheaves in succession and held under tension until connected to the insulators. This process

would be repeated until all the ground wires and conductors were pulled through all sheaves. Conductor splicing would be required at the end of a conductor spool or if a conductor were damaged during stringing. The work would occur on work areas for the structures or pulling/tensioning sites. Conductors would be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end. For public protection during wire installation, guard structures would be erected over roadways, transmission lines, structures, and other obstacles. Guard structures consist of temporary H-frame structures placed on either side of an obstacle.

Helicopters may be necessary to assist in the construction of the line where ground access was not possible or where the contractor decided it would be cost effective. In such cases, helicopters would be used to bring equipment to structure sites, place transmission structures, and string the conductor. This method of construction would replace the need for small portions of access roads in these locations, and would eliminate vehicle access to the structures to perform maintenance activities. Maintenance in these structure locations would be limited to helicopter access and maintenance or pedestrian access. Ground disturbance associated with the use of helicopter construction would include work areas for each structure site measuring about 15 feet by 15 feet, depending on the topography of the site. All necessary equipment would be lowered from a helicopter to allow foundation installation and structure setting. Vegetation would be removed and the work area would be graded by hand to flatten as needed for the safe operation of equipment and access by work crews. In the lead agencies' analysis of the North Miller Creek Alternative (Alternative B) in Chapter 3, no helicopter use to construct structures was assumed. Helicopter use was assumed for line stringing as helicopter use is expected to be less expensive than conventional ground stringing. Helicopter use for line stringing would take about 10 days.

Three conductors with a horizontal spacing of about 20 feet and a vertical spacing of 6.5 feet are proposed. A fiber optic static wire for protection against lightning strikes and communication would be located at the top of each structure 17 feet above the top conductor.

2.8.3 Operation, Maintenance, and Reclamation

The line would be designed and operated to comply with applicable standards. MMC would be governed by the Environmental Specifications for the 230-kV transmission line (Appendix D) to guide line construction, operation, maintenance, and decommissioning activities. To minimize the potential for bird collisions or electrocution, the line would be constructed according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006).

Following construction, land within the right-of-way and other disturbed areas outside of the right-of-way, such as tensioning sites, that had been rutted, compacted, or disturbed would be reclaimed. Access roads would be regraded, scarified, and seeded. All permanent cut-and-fill slopes on maintenance roads would be seeded, fertilized, and stabilized with hydromulch, netting, or other methods. Drive-through dips, open-top box culverts, waterbars, or crossdrains would be installed on maintenance roads to prevent erosion. Unauthorized traffic would be blocked with appropriate structures.

As part of the monitoring program, monitoring at monthly intervals during the growing season would be conducted along the right-of-way and access roads to detect the invasion of spotted knapweed or other noxious weeds. Spotted knapweed plants found on areas disturbed by the

project would be treated by spot spraying individual plants. Herbicides would be carried in tanks mounted on vehicles or in backpack tanks. Herbicide spray would be applied only when wind velocity was less than 8 miles per hour to prevent wind drift. No herbicides would be applied within 25 feet of water bodies. All herbicide applications would be in compliance with all applicable state and federal regulations.

Inspection and repair of the line would be conducted by helicopter. Line inspections would be conducted annually to assess structural integrity and to identify maintenance needs; additional inspections may be needed after a fire or ice storm. MMC estimates a line crew would access the line about 5 days per year for maintenance of hardware and removal of trees. MMC would rely on the BPA followed by Flathead Electrical Cooperative and then MMC's own resources for installation, maintenance, repairs, and inspections.

Hazard trees that would interfere with or fall into the transmission line or associated facilities would be identified during routine maintenance inspections. Targeted trees and tall shrubs would be removed through manual or mechanical means. Clearing of danger trees and tall shrubs would continue until the line was decommissioned. Slash would be lopped and scattered evenly throughout the surrounding terrain. Stumps would be cut to less than 1 foot tall, and lopped slash would be left as close to the ground as possible.

Land use in the right-of-way normally would not be restricted except for those activities that interfere with the line operation and maintenance. Line operation would not require any permanent employees, although MMC would have a trained fire crew and would cooperate with the KNF and local fire departments in controlling forest fires in the area.

MMC expects the transmission line facilities would be the last facilities reclaimed following mine closure. Newly constructed roads needed for construction of the transmission line would be soiled and reseeded immediately after construction was completed. Because the access roads would rarely be used following construction, MMC anticipates these roads would have stabilized naturally or by MMC through interim reclamation. The substation at the plant site would be removed. MMC would remove all other transmission line equipment at closure, such as structures, insulators, line, and other hardware from the right-of-way. All concrete foundations/footers would be broken up and buried in place. Poles and other structures would be dismantled and sold, scraped, and/or disposed of off-site. After the transmission line was removed, all newly constructed roads on National Forest System lands would be bladed and recontoured to match existing topography, obliterating the road prism. Management of newly constructed roads on Plum Creek land after the transmission line was removed would depend on the easement agreement between Plum Creek and MMC. Where culverts were removed, stream banks would be recontoured and reseeded. Native shrubs, such as alder or willow, would be planted on stream banks to reduce bank erosion during high streamflow.

The BPA would dismantle the substation and remove the loop line following mine closure, assuming it had no need for the facilities. The substation and access road would be revegetated after materials had been removed from the site.

2.9 Alternative C—Modified North Miller Creek Transmission Line Alternative

2.9.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal described in Alternative B. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

The primary modification to MMC's proposed North Miller Creek alignment in Alternative B would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation instead of following the Fisher River. This modification would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing soils less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Other modifications to the alignment are relatively small shifts along Miller Creek and an unnamed tributary to Miller Creek. During final design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval. The plan's goal would be to minimize vegetation clearing. The modifications were made to avoid and minimize effects on RHCAs along drainages (Issue 3) and to avoid steep slopes in the headwaters of the unnamed tributary of Miller Creek.

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on Alternative C. In some locations, a helicopter would be used for vegetation clearing and structure construction. The lead agencies selected helicopter use to eliminate the need to use or construct roads in or adjacent to core grizzly bear. Helicopter construction also would reduce effects on lynx habitat. Access roads on National Forest System lands would be placed into intermittent stored service after construction, and decommissioned after the transmission line was decommissioned. Intermittent stored service and road decommissioning are discussed in section 2.9.3.2, *Access Road Construction and Use*. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. The issues addressed by the modifications and mitigation measures are summarized in Table 36. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 36. Response of Alternative C Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.9.2 Alignment and Structure Type

2.9.2.1 Preconstruction Surveys

In Alternatives 3 and 4, MMC would complete before final design and any ground-disturbing activities an intensive cultural resources survey and a jurisdictional wetland delineation on all areas proposed for disturbance for any areas where such surveys have not been completed and that would be disturbed by the alternative. Similarly, MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have not been completed and that would be disturbed by the alternative. Similarly, MMC would conduct surveys in suitable habitat for threatened, endangered, and state-listed plant species potentially occurring on non-National Forest System lands. The surveys would be submitted to the agencies for review and comment. If adverse effects could not be avoided, MMC would develop appropriate mitigation plans for the agencies' approval. The mitigation would be implemented before any ground-disturbing activities. To the extent feasible, MMC would make adjustments to structure and road locations, and other disturbing activities to reduce impacts.

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would traverse an east-facing ridge immediately north northwest of the substation, and would cross Hunter Creek 2 miles north northwest of the substation. The alignment would continue north northwest for 2.5 miles and head west to cross the Fisher River and U.S. 2 a few hundred feed north of MMC's proposed alignment. The alignment would then turn west and generally follow the Miller Creek drainage for 2.5 miles, and then traverse up a tributary to Miller Creek. The alignment would be north of the alignment proposed in Alternative B, reducing the effect on RHCAs along Miller Creek. The alignment would then follow an unnamed tributary of Miller Creek and then cross into the upper Midas Creek drainage, and then down into the Libby Creek drainage, ending at the Libby Plant Site.

MMC would use the same general methods to operate, maintain, and reclaim the line and access roads as Alternative B. Wooden H-frame structures would be used instead of the steel monopoles proposed by MMC in the North Miller Creek Alternative. The lead agencies selected wooden H-frame structures to reduce structure height. H-frame structures also would provide for longer span lengths and consequently would require fewer structures and access roads (Table 31). Using H-frame structures would require more right-of-way and tree clearing (Figure 44). To eliminate the need to use or construct roads that may affect core grizzly bear habitat, structures constructed using a helicopter would be at 21 locations in the Miller Creek, Midas Creek, and Howard Creek drainages (Figure 45).

Based on a preliminary design, two structures would be in a RHCA on National Forest System lands and four structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.9.3 Line and Road Construction Methods

2.9.3.1 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the following changes. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. During final

design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval (see section 2.5.3.2.1, *Vegetation Removal and Disposition* in the Alternative 3 discussion). One of the plan's goals would be to minimize vegetation clearing. The plan would identify areas where clearing would be avoided, such as deep valleys with high line clearance, and measures that would be implemented to minimize clearing. The plan also would evaluate the potential uses of vegetation removed from disturbed areas, and describe disposition and storage plans during life of the line. For example, the growth factor used to assess which trees would require clearing could be reduced in sensitive areas, such as RHCAs, from 15 years to 5 to 8 years. Reducing the growth factor could reduce clearing width, but increase maintenance costs. Heavy equipment use in RHCAs would be minimized. Shrubs in RHCAs would be left in place unless they had to be removed for safety reasons. Vegetation management in riparian areas on private lands would be decided by MMC and the private landowner.

Most construction activity would be contained in the 150-foot right-of-way with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along the entire alignment (Figure 44). In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear timber, reducing the need for access roads (Figure 45). Conventional vegetation clearing techniques would be used in other areas. Merchantable timber would be transported to designated landings or staging areas, and branches and tops would be removed and piled. Helicopter landing sites would generally be on roads (Figure 45). The KNF would be responsible for disposing of the piles. Non-merchantable material would be left within the transmission line clearing area, and would be lopped and scattered. Large woody debris would be left as necessary to comply with the wildlife mitigation described in Alternative 3 (see section 2.5.7.3.2, *Key Habitats*).

2.9.3.2 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to Alternative B. Estimated access road requirements are shown on Figure 45. A final Road Management Plan described in Alternative 3 (section 2.5.4.5.1, *Road Management Plan*) would be developed and implemented for Alternatives C, D, and E.

During final design, MMC would conduct a field inspection with the agencies to review all stream crossings by new roads. The type of stream crossing would be determined based on the field inspection. Where needed, culverts would be sized generally to convey the 100-year storm, but culvert sizing would be determined on a case-by-case basis with the lead agencies' approval of final sizing.

In all transmission line alternatives, roads built for the installation of the transmission line would be needed for future reclamation of the line. The KNF would change the status of new transmission line roads on National Forest System lands to intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to motorized traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. They would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Intermittent stored service roads would require some work to return them to a drivable condition. Intermittent stored service road treatments would include:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities

- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high-risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function
- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

New transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. In addition to all the intermittent stored service road treatments, a decommissioned road would be treated by one or more of the following measures:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary
- Stabilizing fill slopes
- Fully obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism
- Removing unstable fills

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Alternative C would not require roads or structures on any other private land other than Plum Creek. Alternative C would require the use of roads currently barriered with no administrative use. Table 37 lists those roads with a change in road status in Alternative C. These two roads are on Plum Creek land just west of U.S. 2 and are currently closed to public access. Consequently, the two roads are not shown on any figure.

2.9.3.3 Line Stringing

A helicopter would be used for line and ground wire stringing in Alternative C.

Table 37. Proposed Change in Road Status, Alternative C.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
99834	Waylett Flat 99834	On Plum Creek land just west of U.S. 2	Barriered	0.1	Gated, MMC and Plum Creek traffic only
99834A	Waylett Flat 99834A	On Plum Creek land just west of U.S. 2	Barriered	<0.1	Gated, MMC and Plum Creek traffic only

2.9.3.4 Operation, Maintenance, and Reclamation

As in Alternative B, annual inspection of the line would be conducted by helicopter in the other transmission line alternatives. Roads placed in intermittent stored service or decommissioned would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Increased helicopter use would be required to conduct routine maintenance. Clearing of danger trees would continue until the line was decommissioned.

2.9.4 Wildlife Mitigation Measures

Mitigation common to both the mine and transmission line alternatives is discussed in section 2.5.7, *Mitigation Plans* under Mine Alternative 3. Some monitoring described for Mine Alternative 3 also would apply to transmission line alternatives (see section 2.5.6, *Operational and Post-Operational Monitoring Programs*).

2.9.4.1 Down Wood Habitat

MMC would leave large woody material for small mammals and other wildlife species within the cleared transmission line corridor on National Forest System lands. Woody material would be scattered and not concentrated within the clearing area. Piece size should exceed 3 inches in diameter, and preference would be for a down “log” to be at least 8 feet in length with a small-end diameter of 6 inches or more. This material would originate from existing logs on site, unused portions of designated cut trees, broken tops, or similar materials. This mitigation would be incorporated into the Vegetation Removal and Disposition Plan. Monitoring of woody material would be implemented through a timber sale contract. The following amounts of coarse woody debris (CWD) would be left:

- Vegetative Response Unit (VRU) 1: leave 5 to 9 tons (6 to 14 logs) per acre of CWD on site after timber clearing
- Vegetative Response Unit (VRU) 2 and 9: leave 10 to 15 tons (15 to 20 logs) per acre of CWD on site after timber clearing
- Vegetative Response Unit (VRU) 3, 4, and 5: leave 15 to 30 tons (23 to 30 logs) per acre of CWD on site after timber clearing

2.9.4.2 Sensitive Species and Other Species of Interest

2.9.4.2.1 Bald Eagle

MMC would fund or conduct field and/or aerial reconnaissance surveys to locate any new bald eagle or osprey nests along specific segments of the transmission line corridor in Alternatives C, D, and E. Surveys would be conducted between March 15 and April 30, one nesting season prior to transmission line construction. The survey could be integrated into the current monitoring program of the Libby Ranger District, or could be contracted by MMC. Transmission line segments to be surveyed by alternative would be:

- Alternative C: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 19 Township 27 North, Range 29 West in Miller Creek
- Alternative D: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 19 Township 27 North, Range 29 West in Miller Creek; and from the northern end of Section 19 Township 27 North, Range 30 West to the northern edge of Section 13 Township 27 North, Range 31 West, which is the area to the east and northeast of Howard Lake
- Alternative E: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 4 Township 27 North, Range 29 West in West Fisher Creek; and from the northern end of Section 19 Township 27 North, Range 30 West to the northern edge of Section 13 Township 27 North, Range 31 West, which is the area to the east and northeast of Howard Lake

If an active nest were found, guidelines from the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994) would be followed to provide management guidance for the immediate nest site area (Zone 1), the primary use area (Zone 2), and the home range area (Zone 3). This would include delineating a 0.25-mile buffer zone for the nest site area, along with a 0.5-mile buffer zone for the primary use area. High intensity activities, such as heavy equipment use, would not be permitted during the nesting season (February 1 to August 15) within these two zones. Guidelines recommended by the USFWS at the time of project implementation would be followed if different from the Montana Bald Eagle Management Plan Management guidelines.

MMC has committed to constructing the transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006). Specific recommendations that would be implemented are described for migratory birds in section 2.9.4.4, *Migratory Birds* below.

2.9.4.2.2 Western Toad

In transmission line Alternatives C, D, or E, all shrub habitat would be retained in wetlands and riparian areas crossed by the proposed transmission line. Wetlands avoidance, minimization, and mitigation and avoidance measures (see section 2.4.6.1, *Wetland Mitigation Plan*) also would ensure that impacts to western toad breeding habitat were minimized.

2.9.4.3 Elk, White-tailed Deer, and Moose Winter Habitat

MMC would not conduct transmission line construction activities in elk, white-tailed deer, or moose winter range between December 1 and April 30. These timing restrictions may be waived in mild winters if MMC could demonstrate that snow conditions were not limiting the ability of

these species to move freely throughout their range. MMC must receive a written waiver of these timing restrictions from the KNF, DEQ, and FWP, before conducting construction activities on elk, white-tailed deer, or moose winter range between December 1 and April 30. Timing restrictions would not apply to substation construction.

2.9.4.4 Migratory Birds

MMC has committed to constructing the transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006). MMC would ensure the following recommendations would be implemented:

During Construction

- Provide 60-inch minimum horizontal separation between energized conductors and/or energized conductors and grounded hardware.
- Provide 36-inch minimum vertical separation between energized conductors and/or energized conductors and grounded hardware.
- Insulate hardware or conductors against simultaneous contact were adequate spacing were not possible. If transformers, cutouts, or other energized or grounded equipment were present on the structure, then jumpers, cutouts, and bushings should be covered to decrease the chance of a bird electrocution.
- Covering conductors may be necessary at times if adequate separation of conductors, or conductors and grounded parts, could not be achieved. On three phase structures, the cover should extend a minimum of 3 feet from the pole top pin insulator.
- Discourage birds from perching in unsafe locations by installing bird perch guards (triangles) or triangles with perches.
- Increase the visibility of conductors or shield wires where necessary to prevent avian collisions. This may include installation of marker balls, bird diverters, or other line visibility devices placed in varying configurations, depending on line design and location. Areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC.

During Operations

- Replace or modify a structure where there has been a documented problem with a nest site or an avian electrocution. This may include the installation of elevated perches (or nesting platforms in the case of osprey).

2.9.5 Other Modifications

Prior to final design and any ground-disturbing activities, MMC would complete an intensive cultural resources survey and a jurisdictional wetland delineation on all areas proposed for disturbance for any areas where such surveys have not been completed and that would be disturbed by the alternative. MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have

not been completed and that would be disturbed by the alternative. Similarly, MMC would conduct surveys in habitat suitable for threatened, endangered, and state-listed plant species potentially occurring on non-National Forest System lands. Modifications described in Alternative 3 for the mine, such as seed mixtures (Table 18), revegetation success, and weed control, would be implemented in Alternative C.

2.10 Alternative D—Miller Creek Transmission Line Alternative

2.10.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, road construction and post-construction management, line stringing, operation, maintenance, and reclamation, and seed mixtures described in Alternative C. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

Like the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Other modifications to the alignment are relatively small shifts along Miller Creek to avoid RHCAs along drainages (Issue 3). The issue of effects on threatened or endangered species (Issue 5) was addressed by routing the alignment along Miller Creek and avoiding core grizzly bear and lynx habitat in North Miller Creek and the unnamed tributary of Miller Creek.

This alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. In the 1992 Final EIS, a similar alignment was considered, but was eliminated in part because of visual concerns from Howard Lake. The issue of scenic quality from Howard Lake was addressed by using H-frame structures, which would be shorter than steel monopoles. In addition, screening vegetation has grown taller between the lake and the alignment in the intervening 15 years. More detailed engineering was completed for the alternatives analyzed in this EIS, and H-frame structures would be used to minimize the visibility of the line from Howard Lake (Issue 4).

As in Alternative C, a helicopter would be used for vegetation clearing and structure construction in some locations. New access roads on National Forest System lands would be managed in the same manner as Alternative C. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. The issues addressed by the modifications and mitigation measures are summarized in Table 38. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 38. Response of Alternative D Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.10.2 Alignment and Structure Type

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would follow the same alignment as Alternative C until 2 miles west of U.S. 2 (Figure 45). After departing from the Modified North Miller Creek alignment, this alternative would follow Miller Creek to an east-facing ridge separating Miller Creek from the Standard Creek drainage. The alignment would traverse the ridge into the Howard Creek drainage. The alignment would cross the northeast corner of private land about 0.5 mile south of Howard Lake (Figure 45). One structure and a short access road may be located on this property. Past the private land, the alignment would generally parallel Howard Creek and eventually be the same as the Modified North Miller Creek alignment.

The lead agencies selected wooden H-frame structures to reduce structure height. H-frame structures also provide for longer span lengths and consequently fewer structures and access roads (Table 31). Using H-frame structures would require more right of way and tree clearing (Figure 44). To eliminate the need to use or construct roads that may affect core grizzly bear habitat, a helicopter would be used for structure construction at 21 locations in the Miller Creek and Howard Creek drainages (Figure 45). Other mitigation described in Alternative C would be incorporated into Alternative D.

Based on a preliminary design, five structures would be in a RHCA on National Forest System lands and four structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.10.3 Line and Road Construction Methods

2.10.3.1 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to in Alternative B. Estimated access road requirements are shown on Figure 45. MMC would develop and implement a final Road Management Plan. In Alternative D, new access roads on National Forest System lands would be managed in the same manner as Alternative C.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Preliminary design of Alternative D indicates one H-frame structure and one access road to the structure would be needed on each of two private land parcels, one with a residence along Miller Creek west of the Plum Creek parcel and one south of Howard Lake. Road management would depend on the easement agreement between the landowner and MMC. For purposes of analysis, the lead agencies assumed these two roads would be managed in the same manner as roads on Plum Creek lands.

Alternative D would require the use of roads currently barriered with no administrative use. Table 39 lists those roads with a change in road status in Alternative D. These two roads are on Plum Creek land just west of U.S. 2 and are currently closed to public access. Consequently, the two roads are not shown on any figure.

Table 39. Proposed Change in Road Status, Alternative D.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
99834	Waylett Flat 99834	On Plum Creek land just west of U.S. 2	Barriered	0.1	Gated, MMC and Plum Creek traffic only
99834A	Waylett Flat 99834A	On Plum Creek land just west of U.S. 2	Barriered	<0.1	Gated, MMC and Plum Creek traffic only

2.10.3.2 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the modifications of Alternative C incorporated. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. Most construction activity would be contained in the 150-foot right-of-way (Figure 44) with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along the entire alignment (Figure 44). In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear vegetation, reducing the need for access road (Figure 45). Helicopter landing sites would generally be on roads (Figure 45).

2.10.4 Other Modifications

Modifications described in Alternative 3 for the mine or Alternative C for the transmission line (*e.g.*, cultural resource, wildlife, plant, and wetland surveys; wildlife mitigation; seed mixtures (Table 18); revegetation success; and weed control) would be implemented in Alternative D.

2.11 Alternative E—West Fisher Creek Transmission Line Alternative

2.11.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, road construction and post-construction management, line stringing,

operation, maintenance, and reclamation, and seed mixtures described in Alternative C. Some steel monopoles would be used in the steep section 2 miles west of U.S. 2 (Figure 45). This alternative could be selected with any of the mine alternatives. For analysis purposes, the lead agencies assumed this alternative would terminate at the Libby Plant Site.

Like the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alternative by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification would address issues associated with water quality (Issue 2) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line.

The primary difference between the West Fisher Creek Alternative (Alternative E) and the North Miller Creek Alternative (Alternative B) is routing the line on the north side of West Fisher Creek and not up the Miller Creek drainage to minimize effects on core grizzly bear habitat. As in Alternative D, this alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area; H-frame structures would minimize visibility from the lake.

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on this alternative in most locations to minimize the visibility of the line from Howard Lake (Issue 4). In some locations, a helicopter would be used for vegetation clearing and structure construction. New access roads on National Forest System lands would be managed in the same manner as Alternative C. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. The issues addressed by the modifications and mitigation measures are summarized in Table 40. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 40. Response of Alternative E Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.11.2 Alignment and Structure Type

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would follow the same alignment as Alternative C until just north of Hunter Creek (Figure 45). After departing from the Modified North Miller Creek alignment, this alternative would cross the Fisher River and West Fisher Creek and follow West Fisher Creek until its confluence with Standard Creek. It would follow a small tributary to West Fisher Creek, and would eventually be the same as the Miller Creek alignment. Two residences are between 350 and 400 feet of the centerline shown on Figure 78, one near the Fisher River crossing and one on private land 3 miles west of U.S. 2. Montana regulations allow the final centerline to vary by up to 250 feet of the centerline (ARM 17.20.301 (21)) unless there is a compelling reason to increase or decrease this distance. To minimize the risk of elevated electric and magnetic fields, the centerline during final design of this alternative would be no closer than 200 feet of these residences. Electric and magnetic fields are discussed in section 3.19.4.2, *Electrical and Magnetic Fields*.

The lead agencies selected wooden H-frame structures to reduce structure height along most of the West Fisher Creek alignment. H-frame structures also provide for longer span lengths and consequently fewer structures and access roads (Table 31). Using H-frame structures would require more right of way and tree clearing (Figure 44). Some steel monopoles would be used in steep areas 2 miles west of U.S. 2. To eliminate the need to use or construct roads that may affect core grizzly bear habitat, 21 structures along West Fisher Creek would be constructed using a helicopter (Figure 45). Other mitigations described in Alternative C would be incorporated into Alternative E.

Based on a preliminary design, five structures would be in a RHCA on National Forest System lands and eight structures would be in a riparian area on private or state lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.11.3 Line and Road Construction Methods

2.11.3.1 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to in Alternative B. Estimated access road requirements are shown on Figure 45. MMC would develop and implement a final Road Management Plan. New access roads on National Forest System lands in Alternative e would be managed in the same manner as Alternative C.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Preliminary design of Alternative E indicates one H-frame structure and one access road to the structure would be needed on one private land parcel south of Howard Lake. Road management would depend on the easement agreement between the landowner and MMC. For purposes of analysis, the lead agencies assumed this road would be managed in the same manner as roads on Plum Creek lands.

Alternative E would require the use of roads currently barriered with no administrative use. Table 41 lists those roads with a change in road status in Alternative E.

Table 41. Proposed Change in Road Status, Alternative E.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
231A	Libby Creek Fisher River A	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	0.4	Gated, construction traffic only; barriered after construction
4782A	Standard Creek - Miller Creek A	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	1.4	Gated, construction traffic only; barriered after construction
5326	Standard Creek - Miller Creek Oldie	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	0.7	Gated, construction traffic only; barriered after construction
99830	West Fisher 99830	On Plum Creek land 1 mile west of U.S. 2	Barriered	0.2	Gated, MMC and Plum Creek traffic only

2.11.3.2 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the modifications of Alternative C incorporated. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. Most construction activity would be contained in the 150-foot right-of-way (Figure 44) with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along most of the alignment (Figure 44). The right-of-way would be 100 feet and the clearing width would be 150 feet in steep areas 2 miles west of U.S. 2 where steel monopoles would be used. In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear timber, reducing the need for access road (Figure 45). Helicopter landing sites would generally be on roads (Figure 45).

2.11.3.3 Line Stringing

A helicopter would be used for line stringing in Alternative E.

2.11.4 Other Modifications

Modifications described in Alternative 3 for the mine or Alternative C for the transmission line (*e.g.*, cultural resource, wildlife, plant, and wetland surveys; wildlife mitigation; seed mixtures (Table 18); revegetation success; and weed control) would be implemented in Alternative E.

2.12 Forest Plan Amendment

Each mine and transmission line alternative would require an amendment to the KFP in order for the alternative to be consistent with the KFP. The amendment would be completed in accordance with the regulations governing Forest Plan amendments found in 36 CFR 219 and Forest Service

Manual 1921.03. The analysis disclosed in this EIS satisfies the requirements for an evaluation for the amendment.

2.12.1 Mine Facilities

In the 1993 ROD approving the lead agencies' preferred alternative for Noranda's proposed Montanore Project, the KNF amended the KFP and reallocated an area surrounding the Little Cherry Creek Tailings Impoundment Site and the Ramsey Plant Site to Management Area 31 (MA 31). MA 31 is designed to accommodate the activities associated with mineral development on the KNF (USDA Forest Service 1987). Because of improved mapping capabilities between 1993 and 2007 and a slight change in the Little Cherry Creek Tailings Impoundment design from that approved in 1993, all areas currently proposed for disturbance at the Ramsey Plant Site and the Little Cherry Creek Tailings Impoundment Site were not previously reallocated to MA 31. In mine Alternatives 2, 3, and 4, the KNF would amend the KFP by reallocating to MA 31 all areas within the operating permit areas of the selected plant site, the tailings impoundment, and LAD Areas 1 and 2 that currently are not MA 31. In addition, a proposed road and facility corridor that would cross MA 13 (Designated Old Growth) would be reallocated to MA 31. This amendment would apply only to National Forest System lands disturbed by any mine alternative, and would not apply to private lands affected by the mine alternatives. The effects of the amendment are discussed in section 3.14.4, *Environmental Consequences* in the *Land Use* section. Maps showing existing MAs and the proposed reallocation are available at the KNF.

2.12.2 230-kV Transmission Line

In the 1993 ROD approving the lead agencies' preferred alternative for Noranda's proposed Montanore Project, the KNF amended the KFP and reallocated areas crossed by the transmission line classified as corridor avoidance areas (224 acres) to Management Area 23 (MA 23). MA 23 is designed to accommodate the activities associated with electrical transmission corridors on the KNF (USDA Forest Service 1987). Because of improved mapping capabilities between 1993 and 2007 and slight changes in the North Miller Creek transmission line alignment from that approved in 1993, all areas currently proposed for disturbance by MMC's proposed transmission line alignment classified as corridor avoidance areas were not reallocated to MA 23. In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by reallocating certain areas within a 500-foot corridor of the selected 230-kV transmission line on National Forest System lands as MA 23. This amendment would apply only to certain National Forest System lands currently not MA 23 disturbed by any transmission line alternative, and would not apply to private lands crossed by the transmission line alternatives. The effects of the amendment are discussed in section 3.14.4, *Environmental Consequences* in the *Land Use* section. The amendment would apply to the following MAs if crossed by the transmission line under the conditions described:

- MA 10 and 11 if the proposed corridor was within grizzly bear Management Situation 1 or 2 (see section 3.24.5.3, *Grizzly Bear*)
- MAs 2, 6, 12, 13, and 14

The KFP requires wildlife habitat and security be maintained in MAs 15, 16, 17, and 18 by limiting open road density (ORD) to less than or equal to 3 miles per square mile. ORD in MAs 15, 16, 17, and 18 is currently greater than the standard in the Crazy Planning Subunit (PSU), which is a KNF planning area potentially affected by the proposed project. In transmission line

Alternatives B, C, D, and E, the KNF would amend the KFP by allowing the ORD to exceed the KFP standard in the Crazy PSU during and after the project.

2.13 Alternatives Analysis and Rationale for Alternatives Considered but Eliminated

2.13.1 Development of Alternatives

Alternatives were developed based on requirements for alternatives under regulations implementing NEPA, MEPA, MFSA, and Section 404 of the Clean Water Act. To develop a reasonable range of alternatives, the lead agencies separated the proposed Montanore Project into components. *Components* are discrete activities or facilities (*e.g.*, plant site or tailings impoundment) that, when combined with other components, form an alternative. Options were identified for each component. An *option* is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as paste tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. The lead agencies considered options for the following project components:

- Underground mine
- Plant Site and adits
- Tailings impoundment
- LAD Areas
- Access road
- Transmission line

The lead agencies reviewed potential impoundment sites and other alternative components that are described in the following section. The lead agencies' alternatives analysis reviewed the past alternatives analyses efforts, including the KNF's Mineral Activity Coordination Report (the MAC Report) on mineral activity in the Cabinet Mountains (KNF 1986), and analyses conducted by prior project owners as part of the project planning process. As discussed in Chapter 1, the Forest Service, the Montana Department of Health and Environmental Sciences, the DNRC, and the DSL (DEQ's predecessor state agency) prepared a Draft (1990), Supplemental Draft (1991), and Final EIS (USDA Forest Service *et al.* 1992) on the Montanore Project as proposed by Noranda. The 3.5-year environmental review process culminated in 1993 after the KNF and the DSL issued their Records of Decision on the mine, and the Montana Board of Natural Resources and Conservation issued a Certificate of Environmental Compatibility and Public Need, selecting a transmission line alternative similar to that proposed by MMC. The lead agencies' analysis of alternatives considered but eliminated from detailed analysis is discussed in the Final EIS completed in 1992.

The lead agencies completed an alternatives analysis for the Rock Creek Project, a proposed copper-silver mine near Noxon, Montana similar to the proposed Montanore Project, and disclosed the analysis in an Final EIS (USDA Forest Service and DEQ 2001). The Rock Creek Project would mine the same geologic formation (Revett Formation) as the proposed Montanore Project. For the Rock Creek Project, the lead agencies considered many of the same alternatives

considered in the 1992 Final EIS for the Montanore Project. Where applicable, the lead agencies' analysis of the same alternatives discussed in this section is summarized, and the analysis associated with the Rock Creek Project is incorporated by reference (USDA Forest Service and DEQ 2001). The KNF's MAC Report, analyses conducted by prior project owners, the 1992 Montanore Project Final EIS analysis, and the 2001 Rock Creek Project Final EIS analysis are summarized under section 2.13.3, *Prior Environmental Analyses*, following the lead agencies' analysis conducted for this EIS. The past alternatives analysis was updated during the preparation of this EIS. The updated lead agencies' analysis is discussed in section 2.13.2, *2005-2007 Alternatives Analysis*.

2.13.1.1 Regulatory Changes

Since the 1992 Final EIS was issued, a number of regulatory changes occurred. The KNF also has amended the KFP to accommodate the original Montanore Project and other changes to the KFP. The lead agencies' alternatives analysis conducted for MMC's proposal incorporated these changes. The lead agencies evaluated potential sites for a tailings impoundment within a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek. Sites outside a 10-mile radius were not considered practicable because of long tailings transport distances, large elevational differences between the mill and the impoundment, and potential crossing of perennial streams. The resources affected by the regulatory changes within a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek are discussed briefly in the following sections.

2.13.1.1.1 Inland Native Fish Strategy

In 1995, the KNF amended the KFP to adopt the Inland Native Fish Strategy (INFS) (USDA Forest Service 1995). INFS established stream, wetland, and landslide-prone area protection zones called RHCAs, and set standards and guidelines for managing activities that potentially affect conditions within the RHCAs. Standard widths for defining interim RHCAs were based on four categories of streams. For example, for fish-bearing streams, which comprise nearly all the streams in the Montanore Project analysis area, the interim RHCAs consist of the outer edge of the 100-year floodplain, the outer edge of riparian vegetation, the distance equal to the height of two site-potential trees, or 600 feet, including both sides of the stream channel, whichever is greater. INFS also established RMOs that provide guidance with respect to key habitat variables. Section 3.6, *Aquatic Life and Fisheries* discusses INFS and RHCAs in greater detail. RHCAs in a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek are shown in Figure 46. Although RHCAs were not established when the 1992 Final EIS was completed, both the MAC Report and the 1992 Final EIS analysis considered effects on streams and their associated habitats as important resources in facility siting.

2.13.1.1.2 Grizzly Bear

The Montanore Project analysis area is within the Cabinet-Yaak Grizzly Bear Recovery Zone. In 2004, the USDA Forest Service issued a ROD on forest plan amendments in the Idaho Panhandle, Kootenai, and Lolo National Forests for motorized access management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones (USDA Forest Service 2004). The KFP amendment provided motorized access and security guidelines for the grizzly bear. In 2006, a federal district judge set aside the Forest Plan Access Amendment EIS and ROD. Currently, grizzly bear standards are established by: the KFP; consultations since 1987, including the 1995 Amended Biological Opinion and Incidental Take Statement on the 1987 KFP (USFWS 1995); and the Selkirk/Cabinet-Yaak Grizzly Bear Areas Interim Access Management Rule Set from December 1, 1998 (IGBC 1998). Several new analyses included in the KFP Access Amendment are

considered best science applicable to the Montanore Project (Wakkinen and Kasworm 1997; Johnson 2007), and are explained in section 3.24, *Wildlife Resources.*

Standards for core grizzly bear habitat were established in the Selkirk/Cabinet-Yaak Grizzly Bear Areas Interim Access Management Rule Set from December 1, 1998. Core grizzly bear habitat is defined as an area of high quality habitat within a Bear Management Unit that contains no motorized travel routes or high-use trails. Core areas do not include any gated or restricted roads, but may contain roads that are impassable due to vegetation or barriers. Section 3.24, *Wildlife Resources* discusses core grizzly bear habitat in greater detail. Core grizzly bear habitat in a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek was considered during the evaluation of alternatives, along with lynx (Figure 46). Grizzly bear habitat is shown on Figure 90.

2.13.1.1.3 Lynx

In 2000, the USFWS listed the lynx as a threatened species. The KFP has been amended to incorporate standards and guidelines for lynx management established in the Northern Rockies Lynx Management Direction adopted in March 2007 (USDA Forest Service 2007a). Section 3.24, *Wildlife Resources* discusses lynx habitat in greater detail. Lynx habitat in a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek was considered during the evaluation of alternatives (Figure 46). Lynx habitat is shown on Figure 91.

2.13.1.1.4 Bull Trout

In 1998, the USFWS listed the bull trout as a threatened species and in 2005 designated critical habitat in five streams in the project area: Libby Creek, Poorman Creek, Ramsey Creek, Rock Creek, and West Fisher Creek. Section 3.6, *Aquatic Life and Fisheries* discusses bull trout in greater detail. Bull trout are found in Libby, Ramsey, Poorman, Bear, East Fork Rock, and Rock creeks in the mine area, and in the Fisher River and West Fisher and Standard creeks along the transmission line alternative corridors (Figure 46).

2.13.1.1.5 Roadless Areas

Inventoried roadless areas (IRAs) have attributes similar to designated wilderness, such as natural integrity and appearance, opportunities for solitude, and primitive recreation opportunities. IRAs are areas identified in a set of inventoried roadless area maps, contained in the Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, dated November 2000, and any subsequent update or revision of those maps through the land management planning process. The 2000 Roadless Area Conservation Final EIS identified the Barren Peak Inventoried Roadless Area, which is within a 10-mile radius of a plant site in either Ramsey Creek or Libby Creek. It is Forest Service policy to preserve roadless characteristics (see Forest Service Manual §1920). Inventoried roadless areas are discussed in section 3.23, *Wilderness and Inventoried Roadless Areas*. Other land use restrictions in the Montanore Project analysis area are CMW and the Cabinet Face East Roadless Area (Figure 46), which were considered in the 1992 analysis.

2.13.1.1.6 Water Quality

Nondegradation

Section 1.3.2.2, *Water Quality-Related Approvals* discusses previous water quality related approvals associated with the Montanore Project. Pursuant to the 1971 nondegradation statute and regulations then in effect, Noranda submitted a “Petition for Change in Quality of Ambient

Waters" in 1989 to the BHES to request the state's authorization to increase the concentration of select constituents in surface and ground water above ambient concentrations. Noranda submitted supplemental information to support the petition in 1992. Under the 1971 statute, any change in surface or ground water quality above ambient concentrations was prohibited, no matter how small the effect, unless the BHES determined that the changes did not preclude present or anticipated uses of water resources, and were justified as a result of necessary social or economic development.

In response to Noranda's petition, the BHES issued an order in 1992, establishing allowable changes in surface and ground water quality adjacent to the Montanore Project (BHES 1992). The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc (both surface and ground water), as well as nitrate (ground water only), and total inorganic nitrogen (surface water only). These nondegradation limits apply to all surface and ground water affected by the Montanore Project and remain in effect during the operational life of the mine and for so long thereafter as necessary (BHES 1992). The Order is presented in Appendix A.

The Montana Water Quality Act requires the DEQ to protect high quality waters from degradation. The current nondegradation rules were adopted in 1994 in response to amendments to Montana's nondegradation statute in 1993 and apply to any activity resulting from a new or increased source that may degrade a high quality water. These rules do not apply to sources, such as the Montanore Project, that received an authorization to degrade prior to the adoption of the 1993 amendments to Montana's nondegradation statute.

2.13.2 2005-2007 Alternatives Analysis

2.13.2.1 Forest Plan Consistency

2.13.2.1.1 Mine Facilities

As discussed in section 2.2, *Development of Alternatives,* the lead agencies did not identify an alternative that would be in compliance with all KFP standards. For mine facilities, the operating permit areas of the plant site, the tailings impoundment, and LAD Areas 1 and 2 that currently are not MA 31 would be reallocated to MA 31. In addition, a proposed road and facility corridor that would cross MA 13 would be reallocated to MA 31. Although the KFP was amended in 1992 to accommodate the Montanore Project as then approved, all areas proposed for disturbance at the Ramsey Plant Site and the Little Cherry Creek Impoundment Site were not reallocated to MA 31 because of improved mapping capabilities and a slight change in impoundment design. The lead agencies did not identify alternative locations for mine facilities that would avoid amending the KFP to accommodate the proposed operating permit areas of plant site, the tailings impoundment, and LAD Areas 1 and 2.

One of the issues discussed in section 2.13.1.1, *Regulatory Changes* is the KNF's adoption of the INFS standards. One of the INFS standards, Minerals Management 3 (MM), prohibits solid and sanitary waste facilities in RHCAs, unless no alternative exists. Section 2.13.2.4, *Tailings Impoundment,* discusses the lead agencies' analysis of alternative tailings disposal methods and locations. Compliance with INFS was a key criterion in the alternatives analysis. To be consistent with INFS standard MM-3, the lead agencies developed Alternatives 3 and 4 to minimize the extent to which RHCAs would be affected. Alternatives that would eliminate all effects to RHCAs were not practicable.

2.13.2.1.2 Transmission Line Facilities

In the 1992 Final EIS, on-site generation of power was considered in lieu of a transmission line. On-site generation would avoid the need to amend the KFP to accommodate the transmission line. The lead agencies eliminated on-site generation because of high capital costs and the likelihood of additional costs to address environmental concerns, such as air quality (USDA Forest Service *et al.* 1992). On-site generation was eliminated in the current alternatives analysis for the same reasons. It would increase concentrations of priority air pollutants, such as nitrogen and sulfur oxides. The agencies' estimate the capital cost of on-site generation to be $37 million.

Other alternatives that would involve the construction and operation of a transmission line would all cross MAs designated as corridor avoidance areas. The lead agencies did not identify any transmission line alternative that would provide power from the BPA's Noxon-Libby 230-kV transmission line that could avoid MAs designated as corridor avoidance areas.

The lead agencies considered a power source other than BPA's Noxon-Libby 230-kV transmission line. One source would require a new line to the mine from a substation located just north of the town of Libby. The primary advantage of the Libby Creek alignment was that it would follow existing transportation and transmission line corridors over much of its length. The major disadvantages of the Libby Creek alignment were that construction costs would be nearly twice that of several other alignments; operating costs would be substantially higher than several other alignments; and all potential alignments would pass through and adjacent to a much higher population density, affecting substantially more private land than other alignments. It also require amending the KFP where it would cross MAs designated as corridor avoidance areas.

2.13.2.2 Underground Mine

As discussed previously, the Corps and the EPA must follow the 404(b)(1) Guidelines (40 CFR 230) in permitting the discharge of dredged and fill material into wetlands and waters of the U.S. The Corps requested that the lead agencies address the Guidelines in their alternatives analysis and consider alternative locations that could reasonably be obtained for the underground mine not presently owned by MMC. The location of the underground mine is determined by the location of mineralized copper-silver resources. The following sections describe the lead agencies' evaluation of alternative copper-silver resources in northwest Montana, consistent with the Corps' purpose and need described in section 1.5.2, *U.S. Army Corps of Engineers*.

The U.S. Geological Survey (USGS) recently completed a review of copper-silver deposits in western Montana and eastern Idaho (Boleneus *et al.* 2005). A stratabound deposit is a mineral deposit that occurs within a specific stratigraphic bed or horizon, but which does not comprise the entire bed. Worldwide, stratabound copper-silver deposits contain 23 percent of all known copper resources and are the second most important source of the metal. These deposits typically consist of disseminated copper sulfide minerals restricted to a narrow range of mineralized layers within a sedimentary sequence. The Rock Creek, Montanore, and Troy deposits, which are currently the most significant undeveloped resources identified in the western Montana copper belt, are also among the largest stratabound copper-silver deposits in North America and contain about 15 percent of the copper in such deposits in North America (Boleneus *et al.* 2005).

The USGS study covered an area of 4,280 square miles of the western Montana copper belt and spanned 100 miles north-south by 85 miles east-west. The study's purpose was to describe the regional stratigraphy, lithologic characteristics, and alteration patterns of the Revett Formation in

relation to the localization of stratabound copper-silver deposits, along with the exploration potential of the region. The USGS used the term “world class deposit” to provide the relationship of the Rock Creek and Montanore deposits to other known stratabound copper-silver deposits in North America. World-class deposits are significant because production from any of them would affect the world’s supply-demand relation for the metal. World-class deposits are those that exceed the 90th percentile of discovered metal, and contain more than 2.2 million tons of copper. Only three world-class stratabound copper-silver deposits are found in North America: the Rock Creek and Montanore deposit; Kona deposit and the White Pine deposit in Michigan (Boleneus *et al.* 2005).

According to Boleneus *et al.* (2005), mineral deposits in the Revett Formation are unusual because they are also rich in silver, a characteristic that sets them apart from many other stratabound copper deposits. Individually, the Rock Creek and Montanore deposits are considered world-class silver deposits, and collectively they contain 680 million troy ounces of silver. Such deposits represent a “supergiant” silver deposit, which Singer (1995 as cited in Boleneus *et al.* 2005) defined as the largest 1 percent of the world’s silver deposits. The right to mine the Rock Creek deposit is owned by another mining company, and could not be reasonably obtained, used, or managed by MMC. Consequently, the lead agencies did not identify any alternative mineralized resources in northwest Montana that MMC could reasonably obtain.

The Montanore mineral deposit itself is not located within regulated waters of the United States. The deposit outcrops near private land adjacent to Rock Lake, and then dips to more than 3,000 feet underground. The deposit would be mined by underground mining methods, and the mining would not result in the discharge of dredged or fill material into waters of the U.S. It is the location of the ancillary surface facilities, such as the plant site and tailings impoundment, that would result in a regulated discharge. The following sections discuss the alternatives considered but eliminated for those ancillary surface facilities. The analysis includes consideration of areas not presently owned by MMC.

2.13.2.3 Plant Site and Adits

The lead agencies used an iterative process to evaluate plant site and adit options. The lead agencies focused on plant sites on the east side of the Cabinet Mountains. The lead agencies evaluated prior alternatives analyses (see section 2.13.3, *Prior Environmental Analyses*), and concluded that plant sites on the west side of Cabinet Mountains were not available, or did not offer any environmental advantages over plant sites on the east side of Cabinet Mountains.

MMC’s proposed plant site location is in upper Ramsey Creek, near the CMW boundary. During an interdisciplinary team meeting in 2006, the lead agencies identified the possibility of locating the plant site in upper Libby Creek to consolidate the disturbances associated with the adits and plant in one drainage. The lead agencies identified the area between the CMW boundary and the confluence of Libby and Howard creeks as possible sites. By locating the plant site in the Libby Creek drainage, the KNF could change the access of Ramsey Creek Road (NFS road #4781) about 0.5 mile west of the junction with NFS road #6210 and create more core grizzly bear habitat. Figure 90 shows the effect of the Ramsey Creek Road on core grizzly bear habitat.

The lead agencies initially considered three sites along Libby Creek upstream of the confluence of Libby and Howard creeks: 1) on private land at the existing Libby Adit Site, 2) farther up Libby Creek on National Forest System land, but outside of the CMW (the upstream site), and 3) farther down Libby Creek on National Forest System land just west of the Libby Creek

Recreational Gold Panning Area, a popular recreation site (the downstream site). The analysis included consideration of locating adits relative to the plant site. The adit would not necessarily need to be located adjacent to the plant site; a conveyor could convey ore from an adit located separately from a plant site. Regulations of the Mine Safety and Health Administration require that underground mines have two or more separate escapeways to the surface from the lowest level of the mine. The escapeways must be positioned so that damage to one will not lessen the effectiveness of the others. In addition, refuge shelters must be provided within 30 minutes' walking distance of all workplaces for every employee who cannot reach the surface within a time limit of 1 hour.

The Libby Adit has been completed to within 2,000 feet of the ore body, and MMC has received DEQ approval to extend the adit to the ore body and to conduct exploration drilling. (The KNF has not approved the activities described in Minor Revision 06-002.) Connecting the existing Libby Adit with the upstream plant site in Libby Creek or extending the Libby Adit to the downstream site would not be practicable due to grade considerations. Therefore, at each site, the lead agencies evaluated the option of driving one adit for conveyor haulage and return ventilation, while using the existing Libby Adit for workers, materials and intake ventilation. This would save tunneling costs, but also would incur more land disturbance in the Libby Creek drainage. The lead agencies' initial analysis is described in a February 1, 2007 letter report by Agapito Associates, Inc. (Agapito Associates, Inc. 2007a); the report is on file in the agencies' project record. Five combinations of adit locations and plant site locations were considered:

- Option 1: Proposed Ramsey Creek Site—MMC's proposal provides the basis for the comparison of the other alternatives. This would require two new adits to the ore body.
- Option 2a: Upstream Site with Use of the Libby Adit—plant site would be upstream of the Libby Adit Site, using the Libby Adit for workers and materials. A new adit would be needed from the plant site to the ore body, with plant facilities in the upper Libby Creek, and office/warehouse/bath-house facilities at the Libby Adit Site. The Libby Adit would have to be enlarged to about the same size as the new adit (25 feet by 25 feet).
- Option 2b: Upstream Site, Independent of the Libby Adit—plant and office facilities would be consolidated in the upper Libby Creek. Two new adits from the plant site to the ore body would be needed. The existing Libby Adit could be used for supplemental ventilation.
- Option 3a: Libby Adit Site, One New Adit, and Enlargement of the Libby Adit—plant and office facilities would be located at the Libby Adit Site.
- Option 3b: Libby Adit Site, Two New Adits—plant and office facilities would be located at the Libby Adit Site. The existing Libby Adit could be used for supplemental ventilation.
- Option 4a: Downstream Site with Use of the Libby Adit—plant site downstream of the Libby Adit Site, using the Libby Adit for men and materials. This would require one new adit from the plant site to the ore body, with plant facilities in the lower Libby Creek, and office/warehouse/bath-house facilities at the Libby Adit Site. The Libby Adit would have to be enlarged.

- Option 4b: Downstream Site, Independent of the Libby Adit—plant and office facilities would be consolidated downstream of the Libby Adit Site. This option would require two new adits from the plant site to the ore body. The existing Libby Adit could be used for supplemental ventilation.

Ten criteria were used to evaluate each option. The criteria focused on 1) the physical settings of the sites; 2) the relationship between the sites and the ore body, the tailings impoundment, and the transmission line; and 3) the avalanche hazard. The 10 criteria used to evaluate the options were:

- Topography
- Avalanche potential
- Tunnel length
- Transmission line distance
- Slurry line distance
- Slurry line grade and head
- Ventilation distance
- Land disturbance
- Emergency egress
- Conveyor distance and grade

An analysis completed by Agapito Associates (2007a) provides additional discussion of the criteria, weighting approach, and rankings of the options. Agapito Associates concluded that all of the options evaluated are feasible as plant site locations, with Option 2a (the upstream site, using the enlarged Libby Adit for men and materials) having a slightly higher rating. After Agapito Associates concluded that all the options were feasible, the lead agencies considered environmental issues. A site in upper Libby Creek was not evaluated further because of RHCAs, wetlands along Libby Creek, proximity to the CMW, and the adjacent inventoried IRA. A site on private land on the north side of Libby Creek was eliminated from further analysis because the site did not provide sufficient room for all required facilities, given the existing facilities on the site.

The lead agencies completed additional analysis of three other options: 1) a site on private land on the south side of Libby Creek at the Libby Adit Site; 2) a site immediately adjacent to the Libby Adit Site upstream on Libby Creek; and 3) a site slightly west of the downstream Libby Creek site evaluated by Agapito Associates. These sites are shown on Figure 47. Most of the private land south of Libby Creek is very steep, with slopes exceeding 50 percent. Wetlands are found along the less steep ground adjacent to Libby Creek. A site on private land on the south side of Libby Creek at the Libby Adit Site was eliminated from detailed analysis because it did not provide sufficient room to locate the required plant facilities. Siting facilities on the south side was limited by very steep slopes and by wetlands on more gentle slopes. A site adjacent to the Libby Adit Site upstream on Libby Creek was eliminated from detailed analysis because it would affect RHCAs or an IRA. The lower Libby Creek site was retained for detailed analysis because it would accommodate all necessary facilities, and would not affect wetlands, RHCAs or an IRA.

2.13.2.4 Tailings Impoundment

2.13.2.4.1 Initial Site Screening

During an interdisciplinary team meeting in 2006, the lead agencies reviewed the three prior environmental analyses of tailings disposal sites. In the 1992 Final EIS, impoundment sites in Midas Creek, Standard Creek, and Little Cherry Creek were evaluated. The lead agencies concluded that the reasons for eliminating the Midas Creek and Standard Creek sites remained valid. The lead agencies identified the possibility of locating the impoundment site north of Poorman Creek to avoid diversion of Little Cherry Creek, a perennial stream. To evaluate this option, the lead agencies developed six options for an impoundment site between Little Cherry Creek and Poorman Creek (Poulter 2007). Three Poorman options were eliminated because the dam was sited on private land that was not owned by MMC, and that could not be reasonably obtained. Two options were eliminated because they did not have adequate capacity or required large dam volumes. The option retained was subsequently refined and is described in this section.

After a preliminary review of the Little Cherry Creek and Poorman impoundment options, the Corps requested the lead agencies re-evaluate the practicability of impoundment sites evaluated in prior alternatives analyses (see section 2.13.3.2, *Tailings Impoundment Sites*). An alternative is considered practicable if "if it is available and it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes" (40 CFR 230.10(a)(2)). Tailings impoundment site evaluations in prior alternatives analyses were completed using lower impoundment capacity requirements than currently necessary for the Montanore Project. The lead agencies used a capacity requirement of 120 million tons, and either surface disposal, underground backfill, or a combination to match the Little Cherry Creek Tailings Impoundment capacity. At the current project life of 16 years, the Little Cherry Creek Tailings Impoundment has an excess capacity of an additional 3 years of mine production, or 22 million tons (Table 7).

Evaluation criteria differed among the previous analyses and did not reflect all current issues discussed in section 2.13.1.1, *Regulatory Changes*. To address the Corps' comment on the previous analyses, the lead agencies completed an alternatives analysis of all impoundment sites previously evaluated in the MAC Report and by Morrison-Knudsen Engineers, Inc. (MKE) (1988) (Figure 48). MMC's Little Cherry Creek site and the Poorman option developed by the lead agencies were included in the analysis. The impoundment sites would be developed in conjunction with a plant site analyzed in the prior environmental analyses (Figure 48), discussed in section 2.13.3.1, *Plant Sites*.

To standardize disturbance areas for the impoundment sites and allow a comparison of impacts, a 2,000-foot buffer was applied to each impoundment footprint developed for the MAC Report or the MKE analysis. A 2,000-foot buffer was used because the disturbance area for the proposed Little Cherry Creek and Poorman impoundments, which include ancillary facilities, is between 1,500 and 2,000 acres, and a 2,000-foot buffer around impoundment footprints resulted in similar areas for all impoundment sites.

Most of the criteria used in the initial screening analysis (Table 42) have been discussed in the previous section 2.13.1.1, *Regulatory Changes*. Other criteria used were the need for a perennial stream diversion, watershed area, private land, grizzly bear security, and the Libby Mining District. Perennial streams are relatively permanent streams that are likely to support wetland, riparian, and aquatic habitat. Sites not requiring a diversion of a perennial stream generally would

have less effect on aquatic ecosystems than sites that would. The watershed area above the centerline of the dam was used to assess the likely size of diversion structures.

Private land was used as criterion to comply with the 404(b)(1) Guidelines. The Guidelines indicate if a site is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered (40 CFR 230.10(a)(2)). In some cases, affected private land was owned by Sterling Mining Company or its affiliated companies on the west side of the Cabinet Mountains, or by Plum Creek on the east of the mountains. Based on correspondence from Sterling Mining Company and its affiliated companies available in the project record regarding the Montanore Project, private land owned by Sterling Mining Company could not be reasonably obtained for tailings disposal purposes for the Montanore Project. Plum Creek plans to sell its non-strategic timberlands, and has sold land in the analysis area. For this reason, the lead agencies considered lands owned by Plum Creek to be reasonably obtainable. It is not known if private land owned by other entities could be reasonably obtained.

Habitat effectiveness is the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity during the active bear year) remaining within a BMU after affected areas and Management Situation 3 lands are subtracted from the total habitat in the BMU. The width of the impact buffer applied to affected areas depends on the type of activity, as recommended in the Cumulative Effects Analysis Process (USDA Forest Service 1988a). Reduced habitat effectiveness was calculated for all impoundment sites and represents the reduction in acreage of secure grizzly bear habitat.

Effects on cultural resources were evaluated by determining effects on the Libby Mining District. The Libby Mining District is a historic district eligible for listing in the National Registry of Historic Places. The district is designed to protect cultural resources associated with mining activity in the Libby Creek area between the 1860s and the 1950s.

Sites affecting bull trout habitat or over 3 acres of IRA (Lower Bear, Upper Bear, Lower Midas, Cable, Libby, Lower Standard, Upper Standard, Smearl, and Ramsey, and unnamed sites 14A and 15A) were eliminated from further consideration because sites that did not affect these resources were available. The McKay Creek site with 3 acres of effect on an IRA was retained because the disturbance area used in the initial analysis could be reconfigured to avoid effects to an IRA. The Upper Midas site was eliminated because of impacts to grizzly bear habitat (541 acres of grizzly core habitat and 635 acres of reduced habitat effectiveness), and reasonable alternatives with less impact to grizzly bear were available.

Sites 11A and 12 (site numbers 2 and 3 on Figure 48) were eliminated because they are owned by Sterling Mining Company or its affiliated companies and they could not be reasonably obtained, utilized, expanded, or managed for tailings disposal purposes. Sites 10A and 21 also were eliminated because they would not have had sufficient tailings capacity and would have needed excessive borrow material. The McKay Creek site was eliminated because it would reduce effectiveness of 819 acres of grizzly bear habitat (Table 42), require diversion of two perennial streams, and affect at least 43 acres of wetlands (USDA Forest Service and DEQ 2001).

Table 42. Initial Screening Analysis of Tailings Impoundment Sites.

Source	Site Name or Desig-nation	Site Number from Figure 48	Water-shed Area (ac.)	Perennial Stream Diversion (yes/no)	Bull Trout Habitat (ft)	Inventoried Roadless Area (ac.)	RHCAs (ac.)	Private Land (ac.)	Old Growth Habitat (ac)	Core Grizzly Bear (ac.)	Reduced Grizzly Bear Habitat Effective-ness (ac.)	Libby Mining District (ac.)
None	Little Cherry (MMC's Proposed Alternative)†	None	1,247	yes	0	0	253	261	151	4	65	566
None	Agency Poorman Option†	None	900	no	0	0	158	0	154	80	86	424
MAC	10A	1	996	no	0	0	103	1,097	0	0	0	0
MAC	11A	2	1,619	no	0	0	388	920	0	31	89	0
MAC	12	3	656	no	0	0	221	577	0	0	49	0
MAC	14A	4	265	no	0	120	146	275	27	43	247	0
MAC	15A	5	975	no	0	565	169	0	137	377	501	482
MAC	19	6	1,012	no	0	0	502	339	428	0	130	1,855
MAC	21	7	852	no	0	0	171	1,810	0	0	0	0
MKE	Cable	21	2,373	yes	7,947	1,129	229	0	246	432	1,366	264
MKE	Crazyman	15	1,778	yes	0	0	171	464	242	0	0	0
MKE	Libby	12	4,293	yes	12,756	1,272	435	92	357	582	920	40
MKE	Little Cherry	19	1,301	yes	0	0	382	157	357	32	241	1,383
MKE	Lower Bear	20	2,535	yes	10,746	0	345	124	417	13	109	898
MKE	Lower Hoodoo	17	2,189	yes	0	0	235	171	164	0	0	91
MKE	Lower Midas	8	3,345	yes	1,351	0	280	194	272	230	223	331
MKE	Lower Standard	13	3,201	yes	5,952	998	287	1	0	647	1,136	4
MKE	McKay	23	1,501	yes	0	3	267	919	0	30	819	0
MKE	Poorman	18	900	no	0	0	215	49	291	87	160	1,134

Source	Site Name or Desig-nation	Site Number from Figure 48	Water-shed Area (ac.)	Perennial Stream Diversion (yes/no)	Bull Trout Habitat (ft)	Inventoried Roadless Area (ac.)	RHCAs (ac.)	Private Land (ac.)	Old Growth Habitat (ac)	Core Grizzly Bear (ac.)	Reduced Grizzly Bear Habitat Effective-ness (ac.)	Libby Mining District (ac.)
MKE	Ramsey	10	3,408	yes	4,429	1,249	337	0	450	516	1,533	392
MKE	Smearl	16	2,139	yes	0	430	286	335	47	394	1,268	64
MKE	Upper Bear	22	3,063	yes	13,640	1,415	326	0	321	463	772	223
MKE	Upper Hoodoo	14	1,385	yes	0	0	97	0	115	0	0	0
MKE	Upper Midas	9	2,136	yes	0	0	180	0	273	541	635	42
MKE	Upper Standard	11	2,352	yes	5,435	887	262	33	0	566	1,049	50

[†]Based on proposed disturbance area.

Source: GIS analysis by ERO Resources Corp. using KNF data.

The MAC impoundment site 19 and MKE (1988) Poorman Creek sites overlapped considerably and were replaced by the Alternative 3 Poorman tailings impoundment option developed by the lead agencies. Similarly, the MKE (1988) Little Cherry Creek impoundment site was replaced by MMC's proposed Little Cherry Creek Impoundment.

2.13.2.4.2 Detailed Site Screening

After initial screening, five impoundment locations were analyzed further: Crazyman, Lower Hoodoo, Upper Hoodoo, Little Cherry, and Poorman. The lead agencies developed conceptual impoundment layouts for the Crazyman and Hoodoo sites based on a 120-million-ton tailings capacity. The two locations in Hoodoo Creek either did not have sufficient capacity or required very large dams and were dismissed from further evaluation. The three sites evaluated further were Little Cherry Creek (MMC's proposal), Poorman, and Crazyman Creek (Figure 49). Features and resource impacts of the three tailings impoundment sites are summarized in Table 43. Impacts are based on the impoundment and dam footprints and not the disturbance area used in the initial screening.

The Little Cherry Creek Tailings Impoundment is described in Alternative 2. It would cover 647 acres and have a 310-foot-high dam. A Crazyman Creek Tailings Impoundment would have a smaller impoundment area and greater dam height than the Little Cherry Creek and Poorman tailings impoundments, disturbing 343 acres and with a maximum dam height of 680 feet. Both the Little Cherry Creek and Poorman sites would have much larger dam volumes than the Crazyman Creek site because of longer dam lengths (10,650 to 11,150 feet) compared to 2,200 feet for Crazyman Creek. Borrow areas would be needed for the Little Cherry Creek and Poorman sites to provide the needed volume.

The Crazyman Creek site would require larger and more diversions. The watershed area for the Crazyman Creek site would be the largest (1,460 acres), and would require a permanent diversion channel larger than that proposed for the Little Cherry Creek site. Two diversion channels would be needed at the Crazyman Creek site, both 12,000 feet long. The Poorman site would have the smallest watershed area, and would not require a permanent diversion channel.

Tailings pipelines to the Crazyman Creek site would be longer than to the other two sites, with total pipeline lengths ranging from 11.6 miles to the Crazyman Creek site to 4.6 miles to the Poorman site. The pipelines to the Crazyman Creek site from a Libby Plant Site would cross five perennial stream crossings: Libby Creek twice, Ramsey Creek, Midas Creek, and Hoodoo Creek. Ramsey Creek and Poorman Creek would be crossed by pipelines to the other two impoundment sites.

Four criteria were used to evaluate effects on hydrology and fisheries: perennial streams, bull trout habitat within and below the impoundment, and RHCAs. Both the Little Cherry Creek and Crazyman Creek sites would require a diversion structure to divert a perennial stream, while the Poorman site would not. The Little Cherry Creek impoundment would fill 1.7 miles of Little Cherry Creek and the Crazyman Creek impoundment would fill 3.0 miles of Crazyman Creek and tributaries. The Poorman impoundment would fill 1.3 miles of intermittent channels that have some perennial flow. None of the three sites would affect a stream occupied by bull trout. The amount of critical bull trout habitat below each impoundment would be similar, ranging from 9.5 miles in the Crazyman Creek site to 10.7 miles in the Poorman site. The Little Cherry Creek site would have the greatest effect on RHCAs (168 acres); some riparian habitat occurring on private land also would be affected. Effects on RHCAs from Poorman (103 acres) and the Crazyman

Creek sites (85 acres) would be less. Little Cherry Creek is a fish-bearing stream with a population of redband trout, a Forest sensitive species. The streams at the Poorman and Crazyman Creek sites are not fish-bearing streams.

Table 43. Comparison of Features and Resource Impacts of Three Tailings Impoundment Sites.

Criteria	Impoundment Option		
	Little Cherry Creek	Poorman	Crazyman Creek
Engineering/Geotechnical			
Impoundment area (acres)	647	675	343
Dam height (feet)	310	320	680
Maximum crest length (feet)	11,150	10,650	2,200
Watershed area (acres)	1,290	910	1,460
Number of diversion channels	1	0	2
Length of diversion channels (feet)	10,800	0	12,460
Stream crossing by tailings pipelines[†]	2	2	5
Tailings pipeline length (miles)[†]	6.4	4.2	11.6
Wildlife			
Grizzly bear core (acres)	0	0	0
Reduced grizzly bear habitat effectiveness (acres)[‡]	65	86	0
Old growth habitat (acres)	119	117	127
Lynx habitat (acres)	405	362	0
Elk security habitat (acres)	0	0	0
Moose winter range (acres)	647	675	343
Hydrology/Fisheries			
RHCAs (acres)	168	85	103
Streams filled by impoundment Perennial (miles) Other streams (miles)	 1.7 0.0	 0.0 1.3	 3.0 0.0
Occupied bull trout habitat within impoundment footprint (feet)	0	0	0
Critical bull trout habitat below impoundment (miles)	10.6	10.7	9.5
Other			
Libby Mining District (acres)	638	675	0
Inventoried roadless area (acres)	0	0	0

[†]From the Libby Plant Site
[‡]From Table 42 and based on the disturbance area (Little Cherry Creek and Poorman sites) or buffer area (Crazyman Creek site)
The length of critical bull trout habitat was calculated from dam to the Kootenai River.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Effects on wildlife were evaluated by considering important grizzly bear, lynx, elk, and moose habitats. Old growth forest provide habitat for a variety of wildlife and aquatic species. None of the three sites would affect core grizzly bear or elk security habitat. The Little Cherry Creek and Poorman sites are within the grizzly bear recovery zone and would reduce grizzly bear habitat effectiveness (Table 42). The Crazyman Creek site is outside of the grizzly bear recovery zone and would not reduce grizzly bear habitat effectiveness (Table 42). All three impoundments would affect similar amounts of old growth. Impacts on lynx habitat would be similar for the Little Cherry Creek and Poorman sites (362 to 405 acres), while no lynx habitat would be affected by the Crazyman Creek site. Effects on moose winter range would be greatest at the Poorman site (675 acres), followed by the Little Cherry Creek site (647 acres), and the Crazyman Creek site (343 acres).

The Little Cherry Creek and Poorman sites would have similar impacts on the Libby Mining District (638 acres and 675 acres, respectively). The Crazyman Creek site would not affect the district. None of the impoundments would affect IRAs.

The lead agencies retained the Little Cherry Creek and Poorman sites for detailed analysis, and eliminated the Crazyman Creek site from detailed analysis. The Crazyman Creek site would have greater effect on perennial streams than the Poorman site, would require larger and more diversions than the Poorman site, and more stream crossings by tailings pipelines. The Crazyman Creek site did not offer environmental advantages over the Poorman site.

2.13.2.5 Backfilling of Tailings

The lead agencies completed an analysis to assess whether it would be feasible to significantly reduce the size of the surface tailings impoundment by placing a portion of the tailings underground as backfill. Secondary objectives were to evaluate if the presence of backfill would (1) have benefits to pillar and roof stability or (2) reduce the potential for surface subsidence (Agapito Associates, Inc. 2008)

Tailings would represent more than 99 percent of the broken rock that would be mined. Therefore, tailings production would be 12,500 tpd initially and ultimately increase to 20,000 tpd, parallel to mine production. The surface tailings impoundment is designed to hold an estimated 120 million tons of tailings. Based on the results of bench-scale flotation tests, the tailings are expected to consist of fine particles with 52 percent finer than 200 mesh [0.074 millimeters (mm)] (MMI 2005a, MMC 2008). This fineness is necessary to liberate the ore from the host rock; this fineness has implications for backfilling feasibility, which are discussed below.

The placement of backfill in underground mines for wall support has a long history. Before the advent of chemical concentration of ores, backfilling was generally limited to waste rock or sand and gravel, and was generally hand-placed in backfilled areas. Backfilling with tailings is a more recent innovation that became popular after the widespread adoption of flotation for base metal concentration in the 1920s and 1930s, which made large quantities of tailings available for backfilling that would otherwise require surface disposal. The lead agencies considered four backfill placement methods commonly used include dry placement, pneumatic placement, hydraulic placement, and placement of a thick slurry or paste. A general discussion of each of these methods and their applicability to the Montanore Project follows.

2.13.2.5.1 Dry Placement of Tailings

With dry placement of backfill, the tailings are typically transported to the backfilling location by a load-haul-dump vehicle or a haulage truck and spread by a wheel loader. Additionally, the tailings require dewatering to 10 to 20 percent water content prior to transport to minimize spillage. The dewatering process usually requires a two-stage process of thickening followed by pressure filtration.

One drawback to this placement method would be the need for a fleet of dedicated vehicles and operators to place and spread the fill. In the case of Montanore, a single haulage truck would require 30 minutes to travel the 3 miles from the mill to the nearest stope and back, excluding dumping time or delays. Allowing for breaks and shift-change, a single truck could achieve at most 13 to 15 loads per 8-hour shift. Assuming a 40-ton payload truck was employed, a single truck can achieve a production rate of 600 tons per shift or 1,800 tons per day (tpd), thus requiring a fleet of 7 trucks and 21 drivers at the initial 12,500-tpd production level and 12 trucks and 33 drivers at the 20,000-tpd production level. A second serious drawback would be the inability to place the backfill close to the roof and the loss of backfill space as a consequence of the clearances required for truck dumping. Because of the costly dewatering, labor-intensive transportation requirements and the inefficient use of backfilling space, the lead agencies eliminated dry placement of tailings (Agapito Associates, Inc. 2008).

2.13.2.5.2 Pneumatic Transport and Placement (Stowing) of Tailings

Pneumatic placement of tailings is not common in metal mines, but is discussed because it is appropriate for some applications. Pneumatic stowing uses compressed air to transport dry tailings through pipe to the tailings placement location. As in the case of dry placement, the tailings would require dewatering and pressure filtration to reduce the water content.

The main drawbacks to this method are the limited capacity [typically less than 200 tons per hour (tph)]of the blowers used to inject the solids into the transport pipe, the limited distances that materials can be transported, and the large compressed-air volumes necessary for transport (typically 1 to 2 cubic feet of air per cubic foot of material stowed). In addition, the tailings must be transported from the dewatering location to the feeder/blower, which cannot be more than a few hundred feet of the backfill location. Because of the costly dewatering, limited transportation distances, and limited placement rate, the lead agencies concluded pneumatic placement of tailings is not technically applicable to or cost-effective for the Montanore Project (Agapito Associates, Inc. 2008).

2.13.2.5.3 Hydraulic Transport and Placement of Tailings

Hydraulic placement of tailings is the most common backfilling method. For hydraulic placement, the tailings are initially size segregated by cycloning; sand (coarse) tailings are used as backfill and the fine tailings are typically disposed on the surface. The sand tailings are pumped with water at a solids content of typically 55 to 65 percent by weight. Each ton of backfill solids placed must be transported with 140 to 200 gallons of water. Most of this water must be drained from the backfill.

In cut-and-fill mines using hydraulic placement of tailings, it is common to add cement to the tailings at a 1:6 ratio to the top 6 inches of the fill to stabilize the mucking floor. It is also common for cement to be added to tailings at a 1:10 ratio near the boundaries of stopes where the fill may be exposed by subsequent mining of an adjacent stope. A free-standing fill stable over heights up to 25 feet can also be obtained using cemented tailings at a 1:30 cement:tailings ratio

for the entire mass of fill. In Canadian mines, it is customary to add cement to the bulk tailings at a ratio of 1:30. In Australia, hydraulic tailings backfill is generally uncemented because of the cost (poor availability) of Portland cement (Agapito Associates, Inc. 2008).

As discussed above, considerable quantities of water must be drained from hydraulic backfills. In many cut-and-fill stopes, the backfill material must be drained and compacted sufficiently to allow equipment to operate on its surface in as little as 24 hours to avoid delays to the mining cycle. At other mines, drainage is required to minimize the potential for liquefaction and unplanned mobilization of the fill in the event of a rockburst or other seismic event. A rule of thumb for backfill stability is that the percolation rate through the fill, as measured in a test cylinder of fill material in the laboratory, should not be less than 4 inches/hr. Experience has shown that, for many backfill materials, this percolation rate is difficult to achieve if more than 10 percent of the particles in the fill are finer than 200 mesh; however, tailings containing up to 10 percent finer than 325 mesh (0.053 mm) have been found to drain satisfactorily at some mines. As mill tailings typically contain significantly more than 10 percent particles finer than 200 mesh, the material finer than 200 mesh is removed using cyclones before the fill is transported underground. The overflow from the cyclones (the fines and excess water) is transported to the surface tailings impoundment for disposal (Agapito Associates, Inc. 2008).

With hydraulically transported fill, the distance between the mill and backfill location is not a limiting factor. For most underground mines, the elevation head between the mill and the backfill location reduces pumping requirements. To minimize the potential for sanding out of the solids and plugging the pipe, minimum pipeline velocities of 5 feet per second (fps) and 8 fps are recommended for tailings and sand/tailings mixtures, respectively.

Hydraulic filling could be employed at Montanore, provided that adequate underground drainage capacity is provided. The sand-sized tailings at Montanore are needed for construction of the dam surrounding the surface tailings impoundment. If the sand-sized tailings were not available for dam construction, it would be necessary to supply this material from surface borrow sources at additional cost. Because the sand tailings represent about 90 percent of the material suitable for placement hydraulically, the lead agencies eliminated hydraulic placement as an acceptable option for Montanore (Agapito Associates, Inc. 2008).

2.13.2.5.4 Placement of Tailings as a High-Density Slurry or Paste

In the 1970s, experiments were performed at several mines in Canada to determine if the tailings transported to and disposed in surface tailings impoundments could be partially dewatered, thereby reducing the water content and increasing the angle of repose. The success of these tests and the adoption of “thickened tailings” disposal led in the 1980s to the concept of tailings being transported underground for backfilling as a high-density slurry or “paste.”

With this transport and placement method, the tailings become a high-density slurry with a solids content of 75 percent to 80 percent by weight. The slurry acts as a viscous material, for which a shear stress must be exceeded before the material will flow. The critical shear stress for paste fills typically ranges between 250 and 800 Pascals (Pa) (0.041 to 0.116 psi) (Boger *et al.* 2006 as cited in Agapito Associates, Inc. 2008). Because of the viscous nature of the paste and the large amounts of energy required to transport paste in the turbulent regime, it is customary to transport paste in the laminar flow regime (Paterson 2006). Two other important attributes of paste fill are the fact that the water is bound into the slurry, so that little drainage is required, and the fact that fines removal is not required. It is recommended that the paste should contain at least 15 percent

finer than 20 micrometers (Hassani and Archibald 1998 as cited in Agapito Associates, Inc. 2008). In addition, it is customary to add from 3 percent to 6 percent Portland cement or a mixture of Portland cement and fly ash as a binder. Because of the increased strength and reduced need for water handling, paste fill has been supplanting conventional hydraulically placed backfill at mines that have been designed and commissioned since 1990.

Effect on Tailings Impoundment Size and Cost

The maximum backfill system capacity of about 6,000 tpd of tailings solids represents 48 percent of the tailings at a production rate of 12,500 tpd and 30 percent of the tailings at a production rate of 20,000 tpd. Assuming a 19-year mine life (MMI 2005a, MMC 2008) and 6,000 tpd of tailings sent underground, the total tailings tonnage sent underground becomes 39.9 million tons. With an estimated 120 million tons of total tailings produced during the life of the mine, this represents a 33 percent reduction in the volume of the tailings impoundment. However, tailings impoundments are usually placed in lifts. A reduction in volume of 33 percent might not result in a reduction in the footprint of the tailings impoundment.

To estimate the change in the footprint of the tailings impoundment, the design of the Little Cherry Creek Tailings Impoundment as proposed by MMI was used (Klohn Crippen 2005; Klohn Crippen 2007). Klohn Crippen estimates that 80 percent of the tailings would be fine tailings and 20 percent would be coarse tailings. Assuming 39.9 million tons of whole tailings were sent underground, 32 million tons of fine tailings would not require surface disposal. Klohn Crippen estimated the surface area versus fine tailings volume at the Little Cherry Creek Tailings Impoundment Site (Klohn Crippen 2007). Eliminating the need for surface disposal of 32 million tons of fine tailings would reduce the fine tailings pond size by 86 acres, or 20 percent of the total fine tailings pond. The footprint of the sand dam also would be smaller. These reduction estimates are a small portion of the 1,928 acres proposed for disturbance at the Little Cherry Creek Tailings Impoundment Site. A reasonable estimate of the reduction in the footprint of the surface tailings is 20 percent and 5 to 10 percent of the total disturbance area of the tailings impoundment and all associated facilities (Agapito Associates, Inc. 2008).

The lead agencies completed a preliminary economic analysis of paste backfilling (Agapito Associates, Inc. 2008). If backfilling were integrated into the mining cycle, the operating cost at Montanore would be comparable to that for a mechanized cut-and-fill mine, and would likely not be economical at Montanore. If delayed backfilling was used that did not interfere with primary mining, the additional operating cost of backfill placement would be incurred. Because of the shallow dip of the Montanore resource, backfilling of a mined-out zone would require a network of placement pipes with frequent valving for flow control. This network would be more complex than the piping networks required in typical cut-and-fill mines and would require additional labor to install it and monitor it during pouring. Therefore, the backfilling cost at Montanore would likely fall in the upper portion of the above cost range indicating that a delayed backfilling operation with independent mining and backfilling would likely not be economical at Montanore. Based on the lead agencies' preliminary economic analysis of incorporating underground backfilling into the Montanore Project, paste backfilling would likely make the project uneconomical. Estimated costs would be substantially greater than the costs normally associated with similar mining projects.

Effect on Risk of Surface Subsidence

Placement of tailings underground as backfill would reduce the potential for surface subsidence, but would not reduce the potential for the collapse of the underground workings. Regardless, there is a low probability for surface subsidence without backfill under the current mine plan (Agapito Associates, Inc. 2006). Subsidence is discussed in more detail in section 3.9.3.1, *Subsidence*.

2.13.2.6 Land Application Disposal Areas

MMC's proposal is to have two LAD Areas, one along the north side of Ramsey Creek (LAD Area 1) and another between Ramsey and Poorman creeks (LAD Area 2) (Figure 7). Most of LAD Area 1 is in timber harvest areas on slopes generally less than 30 percent. The west side of LAD Area 1 affects the Cabinet Face East IRA, and the south side affects old growth and is on the steep slopes of Ramsey Creek. LAD Area 2 is timber harvest areas on the north and south sides, with old growth in the middle part of the area. The lead agencies considered several alternative locations for the LAD Areas. A potential area near the downstream Libby plant site was either too steep or was old growth. A potential area south of the Little Cherry Creek Tailings Impoundment site and east of NFS road #278 (Bear Creek Road) was also considered. The lead agencies are using this area for the Poorman Tailings Impoundment site in Alternative 3, and as a potential borrow area in Alternative 4. No sites were identified that offered environmental advantages over LAD Area 1. The lead agencies reduced the effects of the LAD Areas by modifying the permit and disturbance areas in Alternatives 3 and 4.

2.13.2.7 Access Road

MMC is proposing to use NFS road #278 for access and to convey concentrate to the Libby Loadout. There are four possible routes to provide access to the Libby Creek and Ramsey Creek drainages: NFS road #278 south from U.S. 2 about 10 miles along Big Cherry Creek, NFS road #231 (Libby Creek Road) west from U.S. 2 about 12 miles along West Fisher Creek, NFS road #231 along Libby Creek, and NFS roads #385, #4724, #4780, and #231 up Miller Creek and then into the Libby Creek drainage. The lead agencies eliminated NFS road #231 west from U.S. 2 along West Fisher Creek because it had more stream crossings and would be much longer than the proposed alignment. NFS road #231 along Libby Creek would have more stream crossings and steeper grades than NFS road #278. Greater disturbance than that needed on NFS road #278 would be necessary to make NFS road #231 suitable for access. In addition, two major bridges spanning Libby Creek along NFS road #278 would have to be rebuilt and widened. A segment of this road was moved out of the Libby Creek floodplain several years ago and placed on a very steep hillside to prevent the road from flooding and bridges from being washed out. Widening NFS road #278 to accommodate traffic on the steep hillside would cause a major surface disturbance. The steep hillside alignment has only recently started to stabilize and currently experiences large amounts of rock fall and soil movement during storm events. The use of NFS roads #385, #4724, #4780, and #231 was eliminated because of the length and steep slopes that NFS roads #4724 and #4780 traverse.

2.13.2.8 Transmission Line Alignment Alternatives

2.13.2.8.1 2005 Major Facility Siting Analysis by MMC

In 2005, MMC submitted an application to the DEQ (DNRC's successor under the MFSA) for a MFSA certificate to construct a 230-kV transmission line using the North Miller Creek alignment

approved in 1993 by DNRC. A transmission line alignment analysis was conducted (Power Engineers 2005b). The alignment analysis report discussed all the alternatives considered in the 1992 Final EIS, those analyzed in detail and those eliminated from detailed analysis. The alignment analysis report updated the comparison of the three alignments that were carried forward for detailed analysis: North Miller Creek, Miller Creek, and Swamp Creek. Twenty criteria in six broad categories were used in the comparison of these three alternatives. As discussed in MMC's alignment analysis report, MMC considered the North Miller Creek alternative to be the best of the three alternatives using the report's evaluation criteria. Additional discussion of MMC's evaluation criteria and the alternatives comparison is found in the alignment analysis report (Power Engineers 2005b).

2.13.2.8.2 2005-2007 Lead Agency Alternative Screening

The KNF and the DEQ used an iterative process to develop alternative alignments for the transmission line and to define the criteria with which to evaluate the alternatives. As part of the initial process, the lead agencies mapped and reviewed numerous transmission line alignments. The alignments reviewed were those identified by MMC, modifications of alignments analyzed by MMC, as well as new alignments identified by the lead agencies. The lead agencies also developed criteria with which to evaluate each alternative.

The lead agencies began the screening analysis with the three alignments analyzed in the 1992 Final EIS, as well as the West Fisher Creek alignment. Subsequently, the alignments were slightly modified to improve the alignment. In response to public scoping comments, the lead agencies identified an alternative alignment of a segment immediately north of the proposed Sedlak Park Substation through Plum Creek Timber Company (Plum Creek) land. The alignment would locate the line east of MMC's proposed alignment to address visibility of the line from U.S. 2 and area residences, create a buffer between residences and the line, create a buffer between the Fisher River and the line, and establish a more direct alignment north of the Sedlak Park Substation. The lead agencies also considered two alternatives that avoided Plum Creek lands along U.S. 2 encumbered by a conservation easement held by the FWP. The following alternatives were evaluated using a number of technical and environmental criteria (Figure 50):

- North Miller Creek (MMC's Proposal)
- Modified North Miller Creek
- Modified Miller Creek
- Modified West Fisher Creek 1
- Modified Swamp Creek
- Olson Creek
- Porcupine Creek
- Modified West Fisher Creek 2

The Modified Swamp Creek alternative was eliminated due to the greater effects on old growth, and the unavailability of replacement old growth in the area. The Modified West Fisher Creek 1 was eliminated because it would be longer and would cross more old growth. Because one MFSA siting criterion prefers the use of public lands over private lands the crossing of more private land by this alignment was also a factor. Although the Olson Creek and Porcupine Creek alternatives would be shorter and cross less private land, these two alternatives were eliminated because they would cross the Barren Peak IRA. The remaining four alternatives were retained for detailed analysis. The lead agencies' analysis of possible transmission line alternatives is described in greater detail in the *Transmission Line Screening Report* (ERO Resources Corp. 2006b).

The lead agencies considered locating the transmission line underground. Underground transmission lines typically have less clearing and do not have the visual impact of the transmission lines and structures. Underground transmission lines would have significantly fewer faults, and fewer voltage sags and fewer short- and long-duration interruptions (Electric Power Research Institute 2006). Digging trenches to bury the lines would require greater construction disturbance and would require more time to install. The need for access roads and the associated surface disturbance would be greater. Except along the drainage bottoms, the analysis area is steep, with slopes greater than 30 percent common. Underground line installation and access road construction on steep slopes would have more environmental impact than above-ground construction. Above-ground access vaults would need to be constructed as well as above-ground structures at line termination points. Vegetation would likely have to be restricted within the right of way to avoid reducing soil moisture that is needed to cool the transmission line. Problems with underground systems also would be more difficult to locate and repair. Underground transmission lines would cost between 1.5 and 5 times the amount required to build an overhead line (Electric Power Research Institute 2006). Locating the transmission line underground was dismissed because of the greater surface disturbance and cost.

2.13.3 Prior Environmental Analyses

2.13.3.1 Plant Sites

2.13.3.1.1 Mineral Activity Coordination Report

The primary objective of the MAC Report was to identify reasonable alternatives for locating various facilities associated with the proposed Rock Creek Project and other anticipated mining operations, including Noranda's (now MMC's) Montanore Project. The MAC Report discussed alternatives for locating a mill and tailings impoundment for the Montanore Project on the east and west sides of the CMW. The report was based on general information available at the time. No subsurface site data were available, and the Montanore ore body was considered much smaller than current estimates.

The MAC Report recognized the relationship between mill siting and the location of the ore body, and first evaluated locations for a mill or plant. Criteria used in the MAC Report for mill siting were:

- Within 3.5 miles of the ore body
- At least 25 acres with level terrain, or up to 40 acres on slopes to 20 percent
- Underlain by soils and geology that could reasonably support a mill

Two mill sites on the west side (in the East Fork of Rock Creek or at the confluence of the East and West Forks of Rock Creek), and three mill sites on the east side of the Cabinet Mountains (in upper Libby Creek, Ramsey Creek, and upper West Fisher Creek) were identified for the Montanore ore body. The evaluation of the sites was completed in conjunction with the tailings impoundment sites, discussed in the following section 2.13.2.4, *Tailings Impoundment*. Plant sites evaluated in the MAC report and other prior environmental analyses are shown on Figure 48.

2.13.3.1.2 Montanore Project Owners

The previous owner of the Montanore mineral rights, U.S. Borax, conducted an initial screening evaluation of six possible plant sites: two in upper East Fork Rock Creek, and one each in East

Fork Bull River, and Ramsey, Poorman, and Libby creeks. Plant Sites in Libby, Ramsey, and Rock creeks seemed feasible (Noranda Minerals Corp. 1989). The six plant sites were evaluated in conjunction with four tailings impoundment sites. Plant Sites in upper East Fork Rock Creek and East Fork Bull River were eliminated because of a lack of suitable impoundment sites (see section 2.13.2.4, *Tailings Impoundment*). The Poorman plant site was eliminated because it did not provide any advantages over sites in Ramsey or Libby creek. Borax evaluated two sites in upper Libby Creek and one site in upper Ramsey Creek (Morrison-Knudsen Engineers, Inc. 1988). One of the Libby Creek sites was inside the CMW. All sites were technically feasible. In 1989 Noranda evaluated one plant site in upper Libby and Ramsey creeks (Morrison-Knudsen Engineers, Inc. 1989b). Criteria were access, slope stability, exposure to rockslides and avalanches, foundation conditions, depth to suitable rock for establishing portals, potential for developing adequate working area, and availability of suitable waste rock disposal areas. Borax concluded the Ramsey Plant Site was preferred because of the lower avalanche hazard and better defined adit portal conditions.

2.13.3.1.3 1992 Final EIS

Three plant site alternatives were considered in the 1992 Final EIS: Libby Creek near the existing Libby Adit location, Ramsey Creek downstream from the proposed plant site location, and Little Cherry Creek near the tailings impoundment. Alternatives to Noranda's proposed Ramsey Creek plant site, which is the same as MMC's proposed Ramsey Plant Site, were dismissed for a variety of reasons. A site between the Libby Adit and the wilderness boundary was eliminated in the 1992 Final EIS because of a higher avalanche hazard and greater potential impacts to the grizzly bear. Locations in Ramsey Creek downstream of the proposed site were considered and dismissed because impacts to most environmental resources would be similar to the proposed location. A plant site location near the proposed tailings impoundment in Little Cherry Creek would reduce both visual impacts from the CMW and wildlife impacts in the Ramsey Creek drainage. This location was dismissed in the 1992 Final EIS primarily because of safety considerations and cost.

2.13.3.2 Tailings Impoundment Sites

2.13.3.2.1 MAC Report

In the MAC Report, criteria used for siting a tailings impoundment were:

- Within 10 miles of mill sites identified in the study
- At an elevation lower than the mill sites identified in the study with no significant uphill trends in the tailings pipelines
- On gentle terrain (slopes generally less than 10 percent)
- Underlain by soils and geology favorable for impoundment construction and operation
- Avoided areas that required diversion of major streams

For the Montanore ore body, tailings impoundment sites were identified on both sides of the Cabinet Mountains. Nine alternative combinations of mill sites and tailings impoundments were identified. Three sites evaluated on the east side of the Cabinet Mountains were in the Little Cherry Creek drainage, in a tributary of Howard Creek, and in a tributary to Bramlett Creek. Impoundment sites evaluated in the MAC report and other prior environmental analyses are shown on Figure 48. The report recommended that alternatives in the Libby Creek drainage not

be considered in the Rock Creek Project analysis but be considered in any future detailed evaluation for other mines like the Montanore Project. The MAC Report identified and evaluated impoundment sites in Little Cherry Creek and Midas Creek (KNF 1986).

2.13.3.2.2 Montanore Project Owners

The previous owner of the Montanore mineral rights, U.S. Borax, conducted an initial screening evaluation of possible impoundment sites. Three sites were evaluated on the west side of the Cabinet Mountains, and one site in Little Cherry Creek was evaluated on the east side. The sites on the west side of the Cabinet Mountains, in McKay Creek, Bull River, and Swamp Creek, were eliminated because of technical and environmental concerns. The McKay Creek site was eliminated from further study because it had multiple owners and would require diversion of 12 square miles of drainage. The Bull River site was eliminated from further study because it was in a potential floodplain and for economic reasons. The Swamp Creek site was eliminated from additional study because of the high cost associated with 16 miles of tailings and return water pipelines, and potential hydrologic problems (Noranda 1989; Thompson 1989).

Following the initial screening, MKE indicated that developing either the Poorman site or Little Cherry Creek site for tailings disposal could be costly due to seepage control considerations (Morrison-Knudsen Engineers, Inc. 1988). MKE recommended conducting a reconnaissance on the east side of the Cabinet Mountains to identify potential impoundment site alternatives that could be less costly to develop. In addition, U.S. Borax indicated that a reconnaissance should be made of the upper Libby Creek, west of the wilderness boundary, for a portal and plant site (see the prior discussion of plant sites). In a 1988 study, the following criteria were used to evaluate sites on the east side of the Cabinet Mountains:

- Storage capacity of at least 70,000,000 cubic yards of tailings
- Minimizing impoundment watershed areas
- Minimizing stream diversion requirements

The storage capacity of 70 million cubic yards of tailings was based on initial estimates developed by U.S. Borax. Before the 1988 report was finalized, Borax sold its interest in the project to Noranda. Based on additional evaluation of the ore body, Noranda increased the capacity requirement to 150 million tons in 1988 and then decreased the amount to 120 million tons in 1989. Noranda also requested that MKE review the McKay Creek area, on the west side of the Cabinet Mountains, for a tailings impoundment site. MKE evaluated sites in the following drainages: Standard, Midas, Libby, Ramsey, Cable, Bear, Smearl, Crazyman, Hoodoo, Little Cherry, Poorman, and McKay (Figure 48). In the evaluation of impoundment site alternatives, MKE considered several factors, the most important of which were seepage control, size of dam, and construction material requirements, proximity to a plant site in either upper Libby or Ramsey creek, and watershed area. Except for possibly the McKay Creek site, MKE found that all sites could be designed to store at least 70 million cubic yards of tailings. MKE found that Midas and Standard creek sites were the most acceptable, and recommended further geotechnical investigation of these sites. The other sites had less desirable characteristics.

In 1989, Noranda conducted preliminary geologic and geotechnical investigations on three sites: Midas Creek, Poorman, and Little Cherry Creek (Morrison-Knudsen Engineers, Inc. 1989b). It is not clear why Standard Creek was not investigated further. Criteria used by Noranda for site selection in the 1989 preliminary geologic and geotechnical investigations included:

- Sufficient tailings storage capacity
- Geotechnical characteristics, particularly consideration of subsurface seepage
- Watershed area and stream diversion requirements
- Embankment volume

MKE dismissed the Poorman site from consideration because it lacked sufficient capacity and would require a large volume of earth and rockfill for material balance. In addition, artesian ground water conditions at the site would probably require the installation of pressure relief wells to control uplift pressures in the dam foundation. Noranda found that the Midas Creek site could be developed to store 120 million tons of tailings. The main disadvantage of this site was that the permanent diversion channels would be subject to blockage by slides and debris, which could lead to failure of these channels. The proper performance of these channels would be necessary long term. Failure of the channels would lead to failure of the tailings retention dam by overtopping. Noranda did not consider the Midas Creek site to be economically feasible for tailings impoundment construction. Noranda's 1989 evaluation concluded that the Little Cherry Creek site was the preferred site.

2.13.3.2.3 1992 Final EIS

In the 1992 Final EIS, the lead agencies reviewed Noranda's analysis and completed an analysis independent of Noranda's. The lead agencies' considered numerous environmental and engineering factors, such as impoundment capacity, dam volume and height, surface water control, pipeline considerations, and environmental resources such as fisheries, wetlands and other waters of the U.S., diversion of perennial streams, and threatened and endangered species. Development of a tailings impoundment and mill site in the East Fork Rock Creek drainage was considered but eliminated. Possible impoundment sites in the Rock Creek drainage either lacked sufficient storage capacity, required excessive borrow amounts, or contained potentially unsuitable foundation soils.

In the 1992 Final EIS, impoundment sites in Midas Creek, Standard Creek, and Little Cherry Creek were evaluated. The lead agencies did not identify an alternative tailings impoundment site that would avoid discharge of dredged or fill materials into waters of the United States. The quantity of proposed discharge, local topography, and drainage patterns precluded such an alternative. All three tailings impoundment alternative sites would affect waters of the U.S. and wetlands. All three sites also would require diversion of a perennial stream.

The lead agencies considered a possible site on Standard Creek because it had sufficient storage capacity, and otherwise met the general criteria required for an impoundment siting. The Standard Creek site would affect more miles of perennial streams and more acres of wetlands than the other two sites. The Little Cherry Creek site would affect fewer miles of perennial streams, but more wetland acres than the Midas Creek site. The Little Cherry Creek site would affect the smallest drainage area of the three alternatives, and would require the least amount of stream diversions. No spillway or dam freeboard would be required for reclamation at Little Cherry Creek. Reclamation of the Midas Creek and Standard Creek impoundments would require routing waters onto the impoundment and over a spillway located along the dam abutment. Considering both environmental and engineering factors, the Little Cherry Creek site was determined to be the most practicable and least environmentally damaging tailings impoundment alternative. In 1992,

the lead agencies dismissed Midas Creek and Standard Creek as alternative tailings impoundment sites from detailed analysis.

2.13.3.3 Tailings Disposal Techniques

In the prior environmental analysis of both the Montanore and Rock Creek Projects, several alternative tailings disposal techniques were evaluated but dismissed from detailed analysis (USDA Forest Service *et al.* 1992; USDA Forest Service and DEQ 2001). These alternatives included conventional backfill of tailings into the mine, partial backfill of tailings into the mine using both coarse and fine tailings, and dry storage of tailings.

2.13.3.3.1 Conventional Backfill

Backfilling of tailings into the Montanore mine was evaluated to determine whether it could be used to reduce the size of the tailings impoundment, and whether its use would be needed to prevent subsidence (collapse) of the surface overlying the mine. Backfilling with tailings has traditionally been used in narrow, steeply dipping mineral deposits for ground support to prevent collapse of workings, provide a platform for miners to reach overlying ore, and maximize ore recovery.

Conventional tailings backfill was dismissed from detailed analysis in 1992 for three reasons. First, the use of coarse tailings for backfill would have required surface excavation of a large amount of borrow to replace the tailings for use in embankment construction. This would have resulted in additional surface disturbance. Second, the need for backfill to further limit subsidence potential was not warranted. In 1992, the lead agencies concluded proper sizing and location of pillars, the sizing of roof spans, and the location of roof horizons should prevent any widespread collapse and consequent subsidence. Finally, conventional backfill would add unreasonable costs to the operation, and may have made the operation economically infeasible. Increased capital and operating costs would have resulted from costs associated with backfilling, inefficiencies in the mining operation, and the increased cost to excavate, haul, and place the replacement borrow material (USDA Forest Service *et al.* 1992).

In the Rock Creek Project EIS, the lead agencies dismissed conventional backfilling from further consideration because a surface impoundment would not be eliminated or reduced in size by many acres. At Rock Creek, designated embankment construction materials would require development of an alternate material source and accompanying disturbance area, and backfilling with whole tailings was not a proven technology at the scale (production rate and volumes) of the proposed project (USDA Forest Service and DEQ 2001).

2.13.3.3.2 Partial Backfill

Another alternative considered in the 1992 Final EIS was to use non-densified whole (coarse and fine) tailings to partially fill the mine. At Montanore, this would have required mining to begin near the bottom of the deposit working upward. Whole tailings would then be slurried into the empty stopes (mined-out areas) after mining is completed in that area. The tailings would remain as a weak, saturated mass. This method would deposit tailings only in the lower mine portion because placement near and above the underground crusher, haulageways, and adit entrances would pose a hazard to workers and affect ongoing operations.

This alternative was dismissed from further consideration in 1992 because it offered no environmental advantages over the Proposed Action. There was no substantial reduction in the

size of the surface impoundment under this alternative. In 1992, the lead agencies concluded that starting operations in the lower portion of the deposit would significantly add to initial investment costs both in terms of the time delay to delineate the lower end of the ore body, and the cost for developing additional underground workings to access the lower part of the ore body. The lower grade ore in this area may not have generated sufficient revenues to pay for these additional investments (USDA Forest Service *et al.* 1992).

2.13.3.3.3 "Dry" Tailings

In 1992, the existing filtration methods for creating dry tailings were economical for small-scale operations on the order of hundreds of tons of tailings per day. In 1992, the proposed Montanore Project was planned to process 20,000 tons per day of tailings. The lead agencies eliminated dry tailings in the 1992 Final EIS because of technical and cost constraints (USDA Forest Service *et al.* 1992). In the Rock Creek Project EIS, the lead agencies did not consider dry tailings to be a viable tailings disposal alternative because of technical and operational difficulties that could result from having to mechanically handle large quantities of tailings, the probable need for a backup wet tailings storage, and increased capital and operating costs (USDA Forest Service and DEQ 2001).

2.13.3.4 Access Road

In the 1992 Final EIS, the lead agencies eliminated NFS road #231 from detailed analysis because it would have more stream crossings and have steeper grades than NFS road #278.

2.13.3.5 Transmission Line

In 1992, the KNF and the DNRC considered several sources of power and different transmission line designs, construction methods, and locations. Two alternatives were eliminated from consideration initially due to their excessive costs and infeasibility. Four other alternatives were evaluated further by the lead agencies, but were ultimately eliminated because they were more costly and did not offer any environmental advantages over the alternatives analyzed in detail in the 1992 Final EIS. In 1992, as well as currently, the laws governing siting a major facility such as the proposed 230-kV transmission line allowed the consideration of cost in assessing impacts (75-20-301(1)(c)). The 1992 analysis associated with transmission line is summarized in the following sections (USDA Forest Service *et al.* 1992). Like the previous discussion of prior alternatives analysis associated with the mine facilities, the past alternatives analysis was updated during the preparation of this EIS. The updated lead agencies' analysis is discussed in the previous section 2.13.2.8, *Transmission Line Alignment Alternatives*.

The lead agencies eliminated on-site generation because of high capital costs and the likelihood of additional costs to address environmental concerns, such as air quality. Several power sources on the east side of the Cabinet Mountains were considered to serve the mine. One source would require a new 230-kV line to the mine from an existing substation located just north of the town of Libby. The KNF and the DNRC eliminated the Libby Creek alignment from detailed analysis. The major disadvantages of the Libby Creek alignment were that construction costs would be nearly twice that of several other alignments, operating costs would be substantially higher than several other alignments, and all potential alignments would pass through or adjacent to a much higher population density, affecting substantially more private land than other alignments.

The KNF and the DNRC evaluated a number of options for tapping the area's 230-kV system (USDA Forest Service *et al.* 1992). The lead agencies considered a tap on BPA's Noxon-Libby

230-kV transmission line 7 miles southwest of Pleasant Valley, Montana. This alternative, referred to as Trail Creek, would have required a substation tap on the BPA line in a remote area near the junction of Iron Meadow Creek and the Silver Butte Fisher River. In 1992, this option was not retained by the lead agencies for further detailed study because of its remote location, and environmental concerns about crossing an unroaded area.

The KNF and DNRC evaluated alternatives for the proposed transmission line from a proposed tap site on BPA's Noxon-Libby 230-kV transmission line at Sedlak Park west of Pleasant Valley. Three alignments, Miller Creek, North Miller Creek, and Swamp Creek, were analyzed in detail in the 1992 Final EIS. Two additional alternatives, the West Fisher Creek and Miller Creek/Midas Creek options, were eliminated from detailed consideration in 1992 because they offered no advantages in cost or environmental impact over the alternatives carried forward for detailed analysis.

The West Fisher Creek alignment was eliminated from detailed study because it would be longer than other alignments. The West Fisher Creek alternative would affect more private landowners than other 230-kV alternatives analyzed in detail in the 1992 Final EIS. It also would affect more recreational users due to its location along a major forest access road. The Miller Creek/Midas Creek alignment was eliminated from detailed study because of its greater length and the lack of environmental advantages over other alternatives. In the 1992 Final EIS, the KNF and the DNRC recommended the North Miller Creek alternative as providing the best balance for an alignment, considering the factors used in the 1992 analysis (USDA Forest Service *et al.* 1992).

In the 1992 analysis, the lead agencies considered the use of helicopters to erect the transmission line structures as an alternative to conventional construction methods (USDA Forest Service *et al.* 1992). The lead agencies determined that general use of helicopters in line construction would have little environmental advantage because conventional equipment, such as augers, would be required to excavate foundations for the transmission line structures. Disturbance associated with the access required to move this equipment to each pole location could not be avoided unless more expensive and time-consuming methods (such as hand digging of pole foundation holes) were done. Line maintenance costs also would be increased without ground access to each tower. For these reasons, the lead agencies dismissed this method as a recommended line construction alternative.

2.13.3.6 Joint Venture Mineral Development Combined Mining Operations (Rock Creek Project and Montanore Project)

In the 1992 Final EIS for the Montanore Project, the lead agencies evaluated the potential alternative of combining ASARCO's (now Rock Creek Resources') Rock Creek Project with the Montanore Project (USDA Forest Service *et al.* 1992). A similar analysis was conducted and disclosed in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). In the Montanore Project Final EIS, the lead agencies concluded they had no regulatory authority to require a combined operation.

In the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001), the lead agencies determined that the efficiencies that might be achieved under a combined operation would likely provide for a more cost-efficient operation as compared to two separate operations. The alternative was dismissed for environmental, engineering, and legal reasons (USDA Forest Service and DEQ 2001). If the companies were to develop an operational agreement and propose

a joint operation, the agencies would initiate a NEPA/MEPA review as appropriate to disclose the effects of such a proposal.

2.14 Comparison of Alternatives

The alternatives analyzed in this EIS were developed in response to the significant issues identified during scoping. The lead agencies identified seven significant environmental issues to drive development of alternatives and evaluation of impacts (see section 2.1.2, *Issues*). These alternatives are described in detail in this chapter. A detailed discussion of the alternatives' impacts is contained in Chapter 3. The effects of the alternatives are summarized in the *Summary* section of this EIS.

Chapter 3. Affected Environment and Environmental Consequences

This Chapter describes the environment (including its human elements) in the analysis area and discusses the environmental consequences by resource that may result from implementation of each alternative. It provides the scientific and analytic basis for the comparison of alternatives presented in the *Summary* section of this EIS.

3.1 Terms Used in this EIS

3.1.1 Direct, Indirect, and Cumulative Effects

Environmental effects can be direct, indirect, or cumulative and long or short in duration. Direct effects are those that are caused by the action and occur at the same time and place. Indirect effects are those that are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). The short-term impacts and uses for the mining related aspects of the project are those that would occur during the life of the project. Short-term impacts associated with the transmission line are those that would occur during construction and the 5 years that DEQ would hold the bond for reclamation of transmission line construction-related disturbances. Long-term impacts of the project are those that would persist beyond mine closure and final reclamation.

After mining and milling operations cease, reclamation and closure activities would consist generally of two phases. The first phase would involve the removal of underground and surface facilities, closure of underground workings, and reclamation of surface disturbances in accordance with the approved operating plan. Included in this would be the dewatering and capping of the tailings impoundment as described in section 2.4.3.1.6, *Tailings Impoundment and Borrow Areas*. It is estimated that the dewatering of the tailings impoundment could last from 5 to 20 years, and is assessed in the impact analysis that follows in this chapter.

The second phase would involve long-term maintenance of specific facilities, such as the Libby Adit Water Treatment Plant or the seepage return facilities at the tailings impoundment. MMC would maintain and operate these facilities until water quality standards are met in all receiving waters from the specific discharge. MMC also would continue water monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment operates, the agencies would require a bond for the operation and maintenance of the water treatment plant. The level of human activity associated with facility operation, maintenance, and monitoring is unknown, but has the potential of being a daily requirement and year-round in duration. The length of time that the second phase of closure activities would occur is not known, but may be decades or more.

Cumulative effects are those that result from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Past and current activities and natural events have contributed to creating the existing condition and trends, as described in the *Affected Environment* sections of this chapter. Additionally, some of these activities may continue to produce environmental effects on issues or resources relevant to the proposal. The list of activities considered in the cumulative effects

analysis was taken from the KNF's Schedule of Proposed Actions and from KNF program managers. Many resources in the KNF are managed by PSUs, which are management areas generally based on fifth-order drainages. Unless otherwise stated, the area encompassing activities included in the cumulative effects analysis for the Montanore Project includes the PSUs potentially affected by the project, namely the Treasure, Crazy, Silverfish, and Rock PSUs. A comprehensive list of individual past and current activities provided by KNF resource specialists is provided in Appendix E. Figure 51 shows activities considered in the cumulative effects analysis.

Activities on public and private lands have been considered. Data on private lands are the best available information derived from landowners and field verification, and are generally more limited than data on public lands. The types of actions (past and current or reasonably foreseeable) analyzed in the cumulative effects analysis can be grouped into four categories:

- Mining Activities
- KNF Land Management Activities
- Private Land Activities
- Other Government Agency Activities

3.1.2 Irreversible or Irretrievable Commitment of Resources

As required by NEPA, this section also includes a discussion by resource of any irreversible or irretrievable commitment of resources that would result from implementing the alternatives. An irreversible commitment of resources means that non-renewable resources are consumed or destroyed. These resources are permanently lost due to project implementation. An irretrievable commitment of resources is the loss of resources or resource production, or use of renewable resources, during project construction and during the period of time that the project is in place.

3.2 Past and Current Actions

3.2.1 Mining Activities

3.2.1.1 Other Minerals Activities

Numerous mining claims are within the Treasure, Crazy, Silverfish, and Rock PSUs, some of which were mined previously, are abandoned, or are active. While many of these claims are for mineral lodes, some are for gravel pits on National Forest System lands that provide mineral material for Forest Service road projects. Also, several Plans of Operation have been approved for stream suction dredging and exploratory digging in these PSUs.

3.2.2 KNF Management Activities

3.2.2.1 Bear Lakes Access

The proposed action in the EA completed by the KNF will permit the owners of the Bear Lakes Ranch reasonable access to a cabin on Bear Lakes Ranch. The action proposed by the KNF will permit the owners to use either the Bear Lakes Trail #178 or the Divide Cut-off Trail #63 via the Iron Meadow Trail #113 for horse and pack stock access to the cabin on Bear Lakes Ranch. The

owners of the ranch will then be permitted to use a portion of the non-system trail into Big Bear Lake Basin and construct a new trail to the cabin as designated by the KNF. About 1,000 feet of new trail will be constructed to access the private land. The new construction will involve a limited amount of blasting (*i.e.*, one day involving four to six blasts) and will occur in designated wilderness (USDA Forest Service 2005b).

3.2.2.2 Snowshoe Mine and Snowshoe Creek CERCLA Project

The KNF prepared a Removal Action Engineering Evaluation/Cost Analysis that evaluated removal alternatives for mine waste located within the Snowshoe and Big Cherry Creek drainages on the KNF near Libby (Maxim Technologies 2004). The principal environmental issues at these sites are associated with impacts from historical mining operations. Human health and environmental issues are related to elevated levels of metal contaminants present in mine wastes and contaminants transported in surface water.

Three sites are included in this evaluation: the Snowshoe Mine, Snowshoe Creek, and Big Cherry Millsite. The Snowshoe Mine workings are located 16.5 miles southeast of Libby on patented mining claims. Activities at the Snowshoe Mine have impacted National Forest System lands downstream of the mine site for a distance of 3 miles in Snowshoe Creek, a tributary to Big Cherry Creek (Pioneer Technical Services, Inc. 2005). The preferred alternatives for the Snowshoe Mine and Snowshoe Creek sites include total removal of tailings to an on-site repository. Stabilizing the sites through total removal of tailings and mine waste, stream reconstruction, backfilling/soiling, and revegetation will reduce erosion of waste at the sites. Any residual contaminants left in native soil beneath excavated tailings areas will be covered and vegetated. Road reconstruction was completed in 2007 and streamside cleanup will be completed in 2008 or 2009.

3.2.2.3 Fuels and Timber Management

A list of past precommercial thinning, prescribed burns, fuels reduction treatments, tree planting, and timber sales activity is provided in Appendix E.

3.2.2.4 Road Construction, Reconstruction, Maintenance

Road construction in the Montanore cumulative affects analysis area is shown by decade on Figure 52. Routine road maintenance is likely to occur as needed on existing roads in the analysis area. The roads most likely to receive maintenance are those open to vehicle traffic.

3.2.2.5 Weed Control

Weed control is ongoing within the analysis area under the KNF Forest Invasive Plant Management Final EIS and associated ROD (KNF 2007a). Under the plan, the KNF will use additional types of herbicides (all water soluble); treat up to 94,000 acres of noxious weeds; adopt an integrated weed management strategy; and broaden noxious weed herbicide control methods to include the use of aerial herbicide applications. Noxious weed management activities also may occur on Plum Creek lands or other private property. A complete inventory of noxious weed management activities is provided in Appendix E.

3.2.2.6 Public Activities Likely to Occur on KNF Lands

Firewood cutting is likely to continue to occur along open roads. Recreational use of the area also will continue and includes driving open roads, snowmobiling, hunting, hiking, berry picking, and other activities. Firewood gathering permits issued from 1985 to 2006 are listed in Appendix E.

One outfitter holds a permit for hunting and trail rides within the Silverfish PSU. A hunting camp is permitted near but outside the CMW. This camp is accessed by a trail using foot or saddle and pack stock.

3.2.3 Private Land Activities

3.2.3.1 Libby Creek Placer Timber Harvest

Libby Creek Placer Company will remove 50,000 to 100,000 board feet of timber annually (except in 2007) on the Libby Placer property. About 20 loads or less are expected to be removed from the property per year for 3 years beginning in 2007.

3.2.3.2 Avista-funded Bull Trout Recovery Activities

Avista Corp. is funding ongoing fish trapping/monitoring activities in Rock Creek and East Fork Bull River. Both drainages have screw traps for capturing out-migrating juvenile trout. In the East Fork Bull River, Avista and FWP will be implementing a non-native suppression program that involves active and passive methods to remove and exclude non-native fish from the river. Fish will be moved to other areas of the Bull River. Channel restoration in the East Fork Bull River occurred in 2007. Avista funded the KNF to complete 1,100 feet of channel restoration to route the stream back into a historical channel to avoid a newly created chronic sediment source. Most of the work will occur on private land.

3.2.4 Other Government Agency Activities

3.2.4.1 FWP Grizzly Bear Management Plan

In response to increasing numbers and expanding distribution of grizzly bears in parts of western Montana, FWP adopted the Grizzly Bear Management Plan for Western Montana (Dood *et al.* 2006). The plan was developed to address the future of grizzly bear management in 17 counties in western Montana outside of the Greater Yellowstone Area. The plan focuses on grizzly bear populations or potential populations in the Northern Continental Divide Ecosystem (NCDE), Cabinet-Yaak Ecosystem, and Bitterroot Ecosystem, as well as surrounding areas. The 10-year plan is being implemented in accordance with and in cooperation with the Grizzly Bear Recovery Plan, to the extent possible under constraints of the ESA until the grizzly bear is delisted. Current approaches to land management, wildlife management, and recreation within the NCDE appear to be providing the conditions needed to establish a population of bears outside the recovery zone. According to the plan, recovery to date in the Cabinet-Yaak Ecosystem has been slow and tenuous, and recovery has yet to begin in the Bitterroot Ecosystem. The purpose of the plan is to provide strategies that can be adapted to local and regional conditions. Issues addressed in the plan include conflict management, habitat monitoring and management, population monitoring and management, harvest management, enforcement, education and public outreach, future research, costs and funding, and expanded local involvement.

Management approaches and guidelines are outlined for each ecosystem. The focus for the Cabinet-Yaak Ecosystem is accelerated recovery through rapid augmentation and reduced human use mortality of the grizzly bear population. In cooperation with USFWS and the Forest Service, 10 to 15 sub-adult male or female, or appropriate adult females, will be relocated from other areas (Yellowstone, NCDE, or Canada) within the next 3 to 5 years. At the present time, the emphasis for augmentation will be on females because it is believed that there are still sufficient males within the area to support recovery. No conflict or habituated and/or food conditioned bears will be used for augmentation, and released animals will be intensively monitored. After the initial effort, the effectiveness of the program will be evaluated and the successes and potential problems of the program will be identified. Programs will be developed to reduce human-caused mortality and to improve or create population linkages, especially between the Cabinet and Yaak populations.

3.2.4.2 DNRC Habitat Conservation Plan

The DNRC Trust Land Management Division (TLMD) is developing a voluntary multi-species habitat conservation plan (HCP) in partnership with the USFWS. The HCP intends to sustain DNRC management practices over time while conserving habitat for five fish and wildlife species, three of which are listed under the ESA. The HCP is being prepared to meet regulatory compliance with Section 10(a)(1)(B) of the ESA. Section 10 provides a regulatory mechanism to allow for the incidental take of federally endangered and threatened species of wildlife by private interests and non-federal government agencies during lawful land practices. The HCP permit period is proposed to extend 50 years and covers forest management activities on classified forested state trust lands that provide habitat for species currently listed or having the potential to be listed under the ESA. Those species include: grizzly bear, Canada lynx, bull trout, westslope cutthroat trout, and redband trout. Activities covered by the HCP will be timber management activities, road construction, reconstruction, maintenance, and use and associated gravel quarrying for forest road surface materials, and grazing. One state land parcel subject to the HCP is found along the West Fisher Creek transmission line alternative.

3.2.4.3 FWP-Plum Creek Conservation Easement

In 2003, Plum Creek initiated a 7-year transaction to sell a conservation easement to the FWP on 142,000 acres in northwest Montana. The Plum Creek Conservation Easement is discussed in section 3.14, *Land Use* and shown on Figure 77.

3.3 Reasonably Foreseeable Future Actions

3.3.1 Mining Activities

3.3.1.1 Rock Creek Project

The Rock Creek Project is an underground copper and silver mine and mill/concentrator complex near Noxon, in Sanders County, Montana. The KNF and the DEQ issued a joint ROD on the project in 2001 (USDA Forest Service and DEQ 2001) and the KNF issued a new ROD in 2003 (USDA Forest Service 2003a) following a revised USFWS BO (USFWS 2003a). The Final BO on the project was issued in 2006 (USFWS 2006). A supplement to the Final BO was issued in 2007 (USFWS 2007a).

The project will include relocation of the lower portion of NFS road #150 and the construction of a mill/concentrator for ore processing, mine waste disposal facilities, various pipelines and access roads, a 230-kV transmission line and associated substation, a rail loading area for transportation of concentrate, and water treatment facilities. The permit area for the project will be 1,560 acres (749 acres of private and 811 acres of National Forest System lands). The project will disturb 482 acres, of which 140 acres will be National Forest System lands, and reduce grizzly bear habitat effectiveness on an estimated 7,044 acres during construction and 6,428 acres during operations. The life of the Rock Creek Project is anticipated to be 35 years. The Rock Creek ore deposit is located beneath and adjacent to the CMW. The ore deposit, mill, and other facilities will be located in the Kaniksu National Forest, which is administered by the KNF in Montana. Access to the proposed project site will be via Montana Highway 200, then 6 miles north on NFS road #150, or the Rock Creek Road.

An evaluation adit will be constructed above the West Fork Rock Creek off of NFS road #2741 near the CMW to gather additional data and to provide ventilation during mining. Support facilities will be constructed, including a temporary wastewater treatment facility to handle water from the evaluation adit prior to discharge to the Clark Fork River or approved percolation basins.

The underground mining operation will use a room-and-pillar mining method. The mineralized zone under the CMW will be accessed through twin adits driven from outside the CMW. A fourth adit may be constructed for ventilation intake with a portal in the CMW if needed. Ore concentrate produced during the milling process will be transported from the mill to the rail loading area via pipeline and then shipped to a smelter by rail. The tailings will be deposited as a paste in an impoundment behind an embankment.

Mine water will be stored seasonally in underground workings; excess water will be discharged to the Clark Fork River after treatment. The water treatment system will include semi-passive biotreatment and a reverse osmosis system. At the end of operations, all remaining surface area disturbances and facilities will be reclaimed. Water treatment of mine water and tailings seepage will continue as long as necessary until each water source meets appropriate water quality standards or limits without treatment. The mine adits will either be a) plugged with concrete bulkheads and sealed once the mine water meets ground water or surface water standards, and the mine workings flooded with mine water, or b) sealed against unauthorized access and the mine water drained or pumped, after treatment, if necessary, to the Clark Fork River in perpetuity.

Development of the evaluation adit will take about a year. Work will start with 39 employees in the first quarter and increase to a maximum of 73 workers in the fourth quarter. Mine construction and production startup will take about 3.5 years. Contract construction will occur during the first 18 months of this phase. It will employ 235 workers initially, increasing to 345 during the fifth quarter. During this same period, employment will start at 34 employees and eventually reach 355 jobs as the mine approached full production. The combined total of contract and company employees will peak at 433 jobs during the fifth quarter before dropping to 92 employees in the seventh quarter.

Permanent operating employment is projected to stabilize at 355. The project will operate 24 hours per day, 7 days per week, and 354 days per year. At the end of production there will be a 2-year shutdown and reclamation period employing 35 workers.

Project mitigation will include the following grizzly bear mitigation measures:

- Secure or protect from development and use (timber harvest, grazing, mining) 2,350 acres of replacement habitat to compensate for acres lost by physical alterations, or acres with reduced habitat availability due to disturbance through conservation easement, including road closures, or acquisition. All replacement habitat (except for the ventilation adit) will be in place prior to the initiation of full operations. Replacement habitat for the ventilation adit will be in place prior to its construction, if the adit becomes necessary.
- Place a berm or barrier on NFS road #4784 within 1 year of issuing the permit for the evaluation adit to increase core area in BMU 5 for the life of the mine.
- Prior to construction, place a barrier on 1.6 miles of NFS road #2285, 0.81 miles of NFS road #2741X, and gate 0.5 mile of NFS road #2741A and 2.92 miles of NFS road #150 year-long.
- Fund two local FWP grizzly bear management specialist positions (with focus on public information and education) and a local FWP law enforcement position to aid in grizzly bear conservation for the life of the mine.
- Defer the construction phase of the mine until at least six female grizzly bears have been augmented into the Cabinet Mountains portion of the Recovery Zone (south of U.S. 2).

The Rock Creek Project is approved by the agencies but no reclamation bond has been posted. DEQ has not issued an operating permit and the KNF has not issued its authorization to implement the proposed Plan of Operations. The evaluation adit phase of the project has been approved but no reclamation bond has been posted.

3.3.1.2 Libby Creek Ventures Drilling Plan

Libby Creek Ventures proposed the drilling of three borings adjacent to the Upper Libby Creek Road (NFS road #2316) on its two claims located in Section 15, Township 27 North, Range 31 West. A 20-ton rotary-hammer type truck-mounted drill rig with a trailer and two pick-up trucks will be used to drill the holes and the active drilling will take place during 3 days. Mobilization and equipment maintenance may increase the total active time to 1 week. The KNF's approved Plan of Operations expired on October 18, 2008 (USDA Forest Service 2007b). About 1 acre of surface disturbance will be associated with the drilling project.

3.3.2 KNF Management Activities

3.3.2.1 Wayup Mine/Fourth of July Road Access

The KNF completed an EIS and issued a ROD for the Wayup Mine and Fourth of July Road Access. The proposed action will permit access across National Forest System lands to private property located in the upper West Fisher Creek drainage. The Wayup Mine is located in the headwaters of West Fisher Creek and the Fourth of July is located near Lower Geiger Lake (USDA Forest Service 2000a, 2000b). The Wayup Mine proposal will involve reconstruction, maintenance, spot reconstruction, and use of two existing roads. These roads will provide the proponent access across National Forest System lands to about 40 acres of private property known as the Wayup Mine. The first road is an existing non-system road and the second road is NFS road #6746. The Fourth of July proposal will involve reconstruction of 0.72 mile of road and

will begin at the end of NFS road #6748 at the Lake Creek trailhead and proceed southwest on the non-system Irish Boy Mine road to a proposed bridge site on Lake Creek. Reconstruction will consist of clearing trees, brush, and stumps from the existing road corridor. It will also include removing slumps, outsloping and installing surface drainage structures, and slash disposal. New construction of 1.8 miles of road would begin at the proposed bridge site and extend to the Fourth of July parcel. Construction would consist of clearing trees, brush, and stumps for a road corridor up to 60 feet wide on steep slopes, earthmoving to create a 12- to 16-foot surface, installation of road surface drainage structures and culverts, construction of one bridge, and slash disposal.

3.3.2.2 Miller-West Fisher Vegetation Management Project

The KNF is preparing an EIS to disclose the environmental effects of vegetation management through commercial timber harvest, precommercial thinning, and prescribed fire; access management changes; trail construction and improvement; treatment of fuels in campgrounds; and watershed rehabilitation activities. The project area is 20 miles south of Libby, Montana in the Silverfish PSU on the Libby Ranger District of the KNF and contains Miller, West Fisher, and Silver Butte Creek watersheds. Alternative 4 of the Miller-West Fisher Vegetation Management Project EIS is the KNF's preferred alternative and is used in the cumulative effects analysis. The project will consist of:

- Vegetation treatments on 5,800 acres, including commercial timber harvest and associated fuel treatments, precommercial thinning, and prescribed burning without associated timber harvest.
- Road and access management, including access changes on 8.7 miles of road; 1.2 miles of new road construction, and 12.1 miles of road storage, and 0.87 mile of road decommissioning. Improvement, construction, and reconstruction of 5.5 miles of trail tread.
- Fuels and hazardous tree removal in Lake Creek Campground.
- Watershed condition improvement in the form of BMP implementation, including installation of ditch relief culverts, culvert replacement, surface water deflectors, and cleaning ditches is proposed for all haul routes. Additional BMP work on roads not used for timber haul is proposed and will be performed as funding becomes available. Stream stabilization projects are also proposed.
- Design features and mitigations to maintain and protect resource values.

3.3.3 Private Lands Activities

3.3.3.1 Poker Hill Rock Quarry

Plum Creek has a permitted a quarry called the Poker Hill site located in W½NE¼, E½NW¼, Section 9, Township 28 North, Range 30 West. The quarry site will have a 16-acre permit area and disturb 3.1 acres for quarrying and 0.5 acre for a staging area. The quarry will produce decorative rock used for landscaping, retaining walls, and masonry. Riprap and gravel may be used for road BMP upgrades and maintenance. Rock tumblers, splitters, crushers, and blasting may be used on the quarry site to help create the desired products.

Reclamation will include recontouring slopes where needed, grass seeding, weed spraying, reshaping high walls and pit areas where possible as described in the general plan of operations.

All access roads, which are needed for future timber management, will be left unreclaimed and maintained up to forestry BMP standards. Access to the quarry will use existing Plum Creek roads.

3.3.3.2 Kootenai Business Park U.S. 2 Entrance Relocation

The current entrance from U.S. 2 to the Kootenai Business Park is in close proximity to a residential area. To accommodate anticipated industrial use and avoid conflicts with residential use, the Libby Port Authority is proposing, in conjunction with the redevelopment of the Kootenai Business Park, to relocate the southern entrance to the Business Park about 400 feet to the south on U.S. 2. The access road from U.S. 2 would be designed and constructed to MDT standards. Construction of the new access road entrance is anticipated to begin in summer of 2009. MMC would use this access to the Libby Loadout.

3.3.3.3 Other Actions on Private Lands

Continued development of private lands within the analysis area is expected. Development is expected to include commercial timber harvest, land clearing, home construction, road construction, septic field installation, water well drilling, livestock grazing, and stabilization of stream banks.

3.4 Air Quality

3.4.1 Regulatory Framework

Under the federal Clean Air Act (amended 1990), EPA sets National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. EPA has set NAAQS for six principal pollutants: carbon monoxide (CO); lead; nitrogen oxides (NO_x); particulate matter with an aerodynamic diameter less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$); ozone; and sulfur oxides (SO_2). These pollutants are referred to as criteria pollutants. The Clean Air Act established two types of standards for criteria pollutants. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (EPA 2006a). Under Montana's implementation of the Clean Air Act, Montana has established Montana Ambient Air Quality Standards (MAAQS) for criteria and other pollutants. NAAQS and MAAQS are presented in Table 46.

An area is designated as attainment when existing concentrations of all regulated pollutants are below the NAAQS and MAAQS. Likewise, an area is designated as non-attainment when existing concentrations of one or more regulated pollutants are above the NAAQS and MAAQS. The Montanore Project production and processing facilities would be located in an area designated as "attainment" for all regulated pollutants.

The city of Libby and surrounding area has been designated a non-attainment area for both $PM_{2.5}$ and PM_{10}. The closest boundary of the PM_{10} non-attainment area is 8.9 miles north of the proposed Little Cherry Creek Tailings Impoundment. The closest boundary of the $PM_{2.5}$ non-attainment area is 1.5 miles north of the tailings impoundment. The Libby Loadout would be located within the Libby PM_{10} and $PM_{2.5}$ non-attainment area.

The Montanore Project would be required to obtain a Montana Air Quality Permit (MAQP) because the facility has the potential to emit more than 25 tons per year (tpy) of one or more criteria air pollutants. The mine and mill (plant) facility would be considered a minor source under the Title V and Prevention of Significant Deterioration (PSD) regulations because total potential emissions from point sources underground and on the surface would be less than 250 tpy for any criteria pollutants. The Montanore Project would not meet the definition of a major source. The Project would be considered a minor source and would not require a Title V operating permit under ARM 17.8.1204 because the potential emissions are less than 100 tpy for any pollutant, less than 10 tpy for any single hazardous air pollutant (HAP), and less than 25 tpy for total HAPs (TRC Environmental Corp. 2006a).

MMC submitted an application for a MAQP in January 2006 (TRC Environmental Corp. 2006a). The application was revised and resubmitted in May 2006 to incorporate additional information and analyses requested by the DEQ ARMB, and the application was deemed complete in July 2006.

The PSD 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 PM_{10}, SO_2 and NO_x that would be allowed in an area. 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. Project facilities would be located in an area designated as Class II under PSD regulations and the CMW is designated as Class I.

The Montanore Project would be a minor source under PSD regulations and, as such, analysis of visibility impacts is not explicitly required (TRC Environmental Corp. 2006b). At the request of the DEQ Air Resources Management Bureau (ARMB), potential plume impairment was evaluated generally following guidance established by the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) in its 2000 Report (FLAG 2000). The FLAG document describes three levels of analysis for plume impairment assessments. Levels one and two are screening level analyses that use the VISCREEN model for assessing plume impairment impacts, and level three is a refined analysis using the PLUVUE II model. (Citation for all models mentioned in this section is available from the Montana ARMB). If a screening analysis demonstrates that visibility impacts from plume impairment are below threshold values, then no further analysis is required.

The PLUVUE II model estimates plume perceptibility in terms of change in color difference (ΔE) and contrast ($|C|$). The Levels of Concern (LOC) or threshold values for plume perceptibility provided in the FLAG document are contrast ($|C| = 0.02$) and change in color difference ($\Delta E = 1.0$).

The Forest Service provides guidance to evaluate the potential impact of sulfur (S) and nitrogen (N) deposition, calculated from sources of SO_2 and NO_x operating during Montanore Mine production. The Forest Service Level of Acceptable Change (LAC) thresholds for lakes with different acid-neutralizing capability (ANC) are (USDA Forest Service 2000c):

10%:	Lakes with ANC > 25 microequivalents/liter (µeq/l)
1 µeq/l:	Lakes with ANC ≤ 25 µeq/l

3.4.2 Analysis Area and Methods

3.4.2.1 Analysis Area

The analysis area is an area around project facilities where air emissions would occur. The facilities are the Ramsey and Libby Plant sites, the Ramsey and Libby Adit sites, the Little Cherry Creek and Poorman tailings impoundment areas, LAD Areas, all access roads, alternate transmission line alignments, Sedlak Park Substation, and the Libby Loadout. The Libby Loadout is included in the analysis area because the loadout would be covered by the DEQ Operating Permit.

3.4.2.2 Methods

3.4.2.2.1 Baseline Data Collection

Meteorological conditions and air quality parameters were monitored between July 1, 1988 and June 30, 1989 at two sites—the Ramsey Creek Air Monitoring Site in the upper Ramsey Creek drainage at the Ramsey Plant Site and the Little Cherry Creek Air Monitoring Site south of the Little Cherry Creek Tailings Impoundment (meteorological data only) (Woodward-Clyde Consultants 1989b). The monitoring locations are shown on Figure 2.3 in the MAQP Application

(TRC Environmental Corp. 2006a). The monitoring results were used in the air quality and visibility analyses for both the 1992 EIS (USDA Forest Service *et al.* 1992) and this EIS. Only data from the Ramsey Creek Air Monitoring Site were used because the data recovery at the Little Cherry Creek Air Monitoring Site was not as complete and because Ramsey Creek Air Monitoring Site meteorological data are more representative of the conditions where a majority of pollutant emissions would be emitted (the Ramsey and Libby adits). The Ramsey Creek Air Monitoring Site meteorological data were combined with twice-daily upper air mixing height data from Spokane, Washington, the closest upper air meteorological site to the mine area (TRC Environmental Corp. 2006a). The baseline meteorological and air quality measurements made during the 1988-1989 baseline year are considered to be representative of 1 year at this site, with the exception of precipitation, which was much lower than normal during this period (section 3.4.3, *Affected Environment*).

Maximum hourly and/or daily and annual average emission rates of PM_{10}, $PM_{2.5}$, total suspended particulates (TSP), NO_x, CO, SO_2, and trace metals including antimony, arsenic, cadmium, chromium, and lead were calculated for all sources and regulated pollutants. Copper and silver were not included because they are not regulated in air. This differentiation between short-term (hourly and daily) and long-term averages applies most specifically to emission sources for which annual operating limits are proposed, but have the potential to operate at maximum load on an hourly and/or 24-hour basis. For modeling purposes, it was assumed mine construction would commence and the mine would phase in production, reaching full production in operating Year 4. Operations for Year 4, the first year of maximum production, were considered the worst-case production emissions scenario and were used for emission calculations (TRC Environmental Corp. 2006a).

Ambient air quality background concentrations were established using monitoring and other available data. Background concentrations were added to modeled concentrations predicted to be emitted from the Montanore Mine to obtain total concentrations for comparison to NAAQS and MAAQS. Annual NO_x concentrations were adjusted using the Ambient Ratio Method. Hourly NO_x concentrations were adjusted using the Ozone Limiting Method (OLM) as described in the Draft Montana Modeling Guideline for Air Quality Permit Applications (DEQ 2007). The ozone ambient standard of 196 micrograms per cubic meter ($\mu g/m^3$) was assumed to be ambient background for the OLM calculation (TRC Environmental Corp. 2006a).

3.4.2.2.2 Impact Analysis

MMC's air permit application included an air dispersion modeling analysis updated from the 1992 EIS analysis, which was conducted to demonstrate compliance with ambient air quality standards following guidance in the Draft Montana Modeling Guideline for Air Quality Permits (DEQ 2007) and in accordance with EPA guidance. The analysis quantified PM_{10}, $PM_{2.5}$, NO_x, SO_2, and lead emissions and their impacts.

Although not required by current regulations and permit requirements, the DEQ requested that MMC conduct additional modeling, including:

- An analysis of impacts to air quality related values (AQRV) in the CMW Class I Area
- Assessment of impacts to Libby PM_{10} and $PM_{2.5}$ non-attainment areas
- Determination of potential effects of terrain-induced downdraft (a sudden drop in terrain causing turbulence on the downwind side which results in mixing and dispersion of air pollutants)

- Potential impacts to ambient air quality from construction activities (TRC Environmental Corp. 2006a)

A visibility impact assessment, acid deposition impact assessment, and comparison of modeled concentrations to PSD Class I Increments are not explicitly required for minor source MAQP applications. Due to the close proximity (0.25 mile) of the mine to the CMW, a PSD Class I Area, the DEQ requested that these analyses be completed (TRC Environmental Corp. 2006a). The DEQ also requested that an analysis be performed to predict ambient PM_{10} and $PM_{2.5}$ contributions from the Montanore Mine to air quality in the Libby non-attainment areas, including the assessment of sulfate and nitrate contribution to total $PM_{2.5}$ impacts (TRC Environmental Corp. 2006a). MMC also submitted new modeling of the impacts from trace metals released during ore, tailings, and concentration mining handling and processing. Montana does not have air toxics impact regulations and MMC is not explicitly required to assess human health risks from metals emissions. MMC provided a screening-type human health risk assessment for trace metals classified as HAPs to provide a full disclosure of potential HAP impacts (DEQ 2006).

None of the modeling completed for the 1992 EIS were used in this Draft EIS. All modeling and analyses are new. Up-to-date models were used and the new data generated by the modeling have been analyzed in this EIS.

Several years ago, the AERMIC (American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee) was formed to introduce state-of-the-art modeling concepts into the EPA's local-scale air quality models. The AERMIC focused on a new platform for regulatory steady-state plume modeling. EPA adopted the recommended new program, AERMOD, in 2005 as the recommended refined model to be applied in areas of simple and complex terrain. The DEQ adopted the EPA recommendation and mandated use of AERMOD in place of Industrial Source Complex (ISC) models. In 2007, MMC completed additional modeling with the following changes:

- The AERMOD modeling system was used to remodel the ambient air quality impact for Alternative 2
- Two options for ventilation were analyzed as for Alternatives 3 and 4 (using AERMOD)

For Alternative 2, all sources remained at the same emission rates and stack parameters as modeled with ISCST3 (ISC Short Term) model, except the Libby Adit portal that was broken into two identically sized sources at the same location. This was done because the algorithms used in the AERMOD model could not process a single source with such a large exit diameter and therefore very small exit velocity. This artificial splitting into two pieces of the Libby Adit portal source to accommodate the AERMOD model requirements is equivalent to the way the source was modeled (as a single source) earlier using ISCST3 (Sage Environmental Consulting 2007).

For Alternatives 3 and 4, the Libby Plant Site would be northeast of the Libby Adit Site, and two adits would be constructed at the Libby Adit Site and one adit at the Upper Libby Adit Site. For the AERMOD modeling of these alternatives, the four plant area emission sources and the emergency generator source were located at the Libby Plant Site. Two ventilation scenarios were modeled for the adits. One modeled scenario assumed all underground emissions exited through

one of the two Libby Adits. In this scenario, the Upper Libby Adit would be used for intake. Libby Adit dimensions were assumed to be the same in all alternatives. All other mine emissions sources were modeled as they were for Alternative 2 (Sage Environmental Consulting 2007).

In another modeled scenario, the assumptions were the same as the first scenario except underground emissions would be split between one of the two Libby Adits and the Upper Libby Upper Adit. The other Libby Adit would be used for intake (Sage Environmental Consulting 2007).

3.4.3 Affected Environment

3.4.3.1 Climate

3.4.3.1.1 Regional Climate

The region has a "modified continental maritime" type of climate. The regional climate is influenced and modified by Pacific Ocean maritime air masses. Summers are warm and dry, and winters are cold. The Pacific Ocean influences development of coastal storms, which occasionally track across the State of Washington, and east into northern Idaho and Montana. The relatively high mountain ranges to the west and north tend to reduce the effects of these storms, so that more rain or snow occurs on the west or north side of the Cabinet Mountains than the south or east sides. In winter, cold Canadian air masses can cause periods of extremely cold temperatures. Cold air movement into the region forms temperature conditions that may trap pollutants near the land surface. More frequently, dry continental air masses from Canada or the east influence the region. In summer, these air masses create conditions of warm temperatures and low humidity.

3.4.3.1.2 Analysis Area Climate

Although similar to the regional climate, the climate of the analysis area is highly influenced by local terrain and elevation. The analysis area's mountainous terrain produces significant precipitation and temperature variations. Analysis area elevations range from 2,600 feet along U.S. 2 to almost 8,000 feet at Elephant Peak in the Cabinet Mountains. Elevation in the City of Libby is 2,062 feet. The terrain in the immediate vicinity of the proposed facilities is mountainous with large changes in elevation over short distances (MMI 2005a).

Wind velocities vary according to terrain features, with higher wind speeds at ridge tops and lower wind speeds in protected valleys. The upper level winds above 10,000 feet come predominantly from the northwest, and surface winds follow topographic relief (valley flow) in times of stable weather activity. Based on wind data collected in 1988-1989, over 50 percent of the winds at the Ramsey Creek Air Monitoring Site and nearly 90 percent of the winds at the Little Cherry Creek Air Monitoring Site were less than 3.5 miles per hour (mph). The average wind speed at Ramsey Creek was 5 mph. The highest wind speed recorded was 28.4 mph at the Ramsey Creek Air Monitoring Site. Wind speed averaged 2.4 mph at the Little Cherry Creek Air Monitoring Site (Woodward-Clyde Consultants 1989b).

Predominant wind directions are from the southwest-to-southeast sectors (Woodward-Clyde Consultants, Inc. 1989b). The measured predominant wind direction at the Ramsey Creek Air Monitoring Site is south-southeast. Maximum wind speeds are also associated with south-southeast winds. This is in contrast to the tendency for upper level winds to be from the northwest. The predominant wind direction is also inconsistent with the orientation of the creek drainage (southwest-to-northeast), although winds from the southwest and south-southwest were

measured about 30 percent of the time. Maximum wind speeds at the Ramsey Creek Air Monitoring Site were associated with south-southeast winds, and with south-southwest winds at the Little Cherry Creek Air Monitoring Site. Valleys in western Montana have a strong potential for the formation of temperature inversions (stable atmospheric conditions with little air mixing).

Precipitation data for the project area are available from a monitoring site in upper Poorman Creek, about 1 mile north of the proposed Ramsey Plant Site. Based on data from 1969 to 1987, the average annual precipitation is 32 inches in the proposed tailings impoundment area (elevation 3,400 to 3,700 feet), with 50 to 60 inches at the Libby Adit and Ramsey Plant sites (elevation 4,000 to 4,500 feet) (Geomatrix 2007a). More recent data (1999 to 2004) show about 10 percent greater precipitation than the 1969 to 1987 data. Precipitation increases with increasing elevation. About 35 percent of precipitation is snow that generally falls between October and May. Rain-on-snow also may occur in mid-winter and early spring, which can result in significant runoff events (Geomatrix 2007a). Temperatures in the analysis area are cold in the winter and mild in the summer. The annual average temperature is about 41°F with a range between -26°F and 95°F (hourly average).

3.4.3.2 Particulate Matter and Gaseous Pollutants

3.4.3.2.1 Airborne Particulate Matter

Concentrations of TSP and PM_{10} are typical of remote, mountainous sites. At the Ramsey Creek Air Monitoring Site, the annual average PM_{10} was 14 $\mu g/m^3$ and the maximum 24-hour concentration was 35 $\mu g/m^3$ (Table 44). PM_{10} concentrations are in compliance with the MAAQS and NAAQS. MAAQS and NAAQS for TSP have been rescinded since the time the data were collected. The maximum measured PM_{10} and TSP values each exceeded their respective standards on one occasion in the fall of 1988, likely due to the numerous forest fires in the region, and do not represent normal background conditions. At the Little Cherry Monitoring Site, the arithmetic mean PM_{10} concentration was 14 $\mu g/m^3$ and the geometric mean for the TSP sampler was 33 $\mu g/m^3$ (Woodward-Clyde Consultants Inc. 1989a).

Table 44 also lists background concentration values for $PM_{2.5}$, NO_x, SO_2, CO, and lead. The $PM_{2.5}$ background values were obtained from the Forest Service IMPROVE site, about 3 miles south of the CMW southern boundary. The NO_x, SO_2, and CO values are typical values provided by DEQ for use in permit modeling analyses. The TSP filters at the Little Cherry Creek Air Monitoring Site were chemically analyzed for trace metals including lead.

Trace metal concentrations measured in the total suspended particulate matter samples were low. None of the monthly values exceed any federal ambient standard or Montana guideline concentration (TRC Environmental Corp. 2006a).

Libby was designated as a non-attainment area for PM_{10} as part of the 1990 Clean Air Act amendments. Airborne particulate levels in Libby and nearby residential areas were above the PM_{10} standard in the 1980s and early 1990s, but are currently lower due to air quality control measures. The last violation of the PM_{10} 24-hour standard was in 1990. The DEQ continues to operate a PM_{10} monitoring site at the Lincoln County Courthouse Annex roof near the center of Libby. In 2005, EPA designated Lincoln County as a non-attainment area for $PM_{2.5}$ based on measured concentrations exceeding the NAAQS for $PM_{2.5}$ set forth in the Clean Air Act.

Table 44. Background Concentrations Used in the Air Quality Modeling.

Pollutant	Averaging Period			
	Annual	24-Hour	3-Hour	1-Hour
PM_{10}	14	35	NA	NA
$PM_{2.5}$	3.5	10.4	NA	NA
NO_x	6	NA	NA	75
SO_2	3	11	26	35
CO	NA	1,150	NA	1,725
Lead	0.006	NA	NA	NA

All concentrations are in micrograms per cubic meter ($\mu g/m^3$)
NA = Not applicable
Source: TRC Environmental Corp. 2006a.

3.4.3.2.2 Gaseous Pollutants

No measurements of other criteria pollutants and their precursors, such as CO, SO_2, ozone, NO_x, or hydrocarbons, were made in the analysis area. Given the remoteness of the analysis area and the lack of air pollution sources and minimal human impact, low background concentrations are expected (Table 44).

3.4.3.3 Visibility

Visibility is usually high, except during times of forest fires or controlled burning. The nearby CMW is classified as a Class I PSD area. This designation is for those areas of the country (such as National Parks and wilderness areas) where little or no air quality degradation is allowed. In addition to strict ambient air quality standards, visibility protection is also required.

3.4.3.4 Acid-neutralizing Capability of Mine Area Lakes

There are two types of acidification that affect lakes and streams. One is a year-round condition when a lake is acidic all year long, referred to as chronically or critically acidic. The other is seasonal or episodic acidification associated with spring melt and/or rain storm events. A lake is considered insensitive when it is not acidified during any time of the year. Lakes with acid-neutralizing capability (ANC) values below 0 µeq/l are considered to be chronically acidic. Lakes with ANC values between 0 and 50 µeq/l are considered susceptible to episodic acidification. In the analysis area, Libby Lakes are the most susceptible to acidification. Upper Libby Lake had an average ANC value of 4.5 µeq/l between 1991 and 2006; Lower Libby Lake's ANC averaged 14.4 µeq/l over the same period. Upper Libby and Lower Libby Lakes have variable but generally declining ANC and stable pH (USDA Forest Service 2008b). The declining trend in ANC in the Libby Lakes is not readily explainable, because no similar trend occurred in the comparable Selway Bitterroot Wilderness, according to the Forest Service's recent analysis of data collected from 1993 through 2007 (USDA Forest Service 2008b). Rock Lake's ANC ranged from 44 to 60 µeq/l in one sample event each in 1991, 1992, (USDA Forest Service 2008b) and 1999 (Gurrieri and Furniss 2004). St. Paul Lake's ANC was 168 µeq/l when measured in 1991 (USDA Forest Service 2008c).

Sulfate (SO_4) and nitrate (NO_3) are acidifying anions. Because alpine lakes are sensitive to pH change, sulfate and nitrate levels are monitored for annual variations. Despite overall trends in the

west of decreasing SO_4, the lakes did not show a decreasing SO_4 trend. This may be due to weatherization of bedrock surrounding the lakes or the lakes may be too far from sulfates source to be significantly affected by emission decreases. No strong trends in NO_3 and NH_4 are discernible. Overall NH_4 levels appear to be increasing slightly in the CMW. The NO_3 appears to be fairly stable or decreasing. A decrease trend in nitrate does not fit with the overall increasing trend throughout the west. The low nitrate concentrations, which include non-detectable for most sampling events, are likely due to quick assimilation by precipitation and watershed source nitrate by phytoplankton except for Upper Libby Lake, which is very oligotrophic and has limited algae, which evidently reduces nitrate assimilation rates (USDA Forest Service 2008b).

3.4.4 Environmental Consequences

3.4.4.1 Alternative 1 – No Mine

The increased air emissions from mine construction and operation described under the mine alternatives would not occur. The ambient air quality and visibility in the CMW would not be affected by the proposed mine. Existing trends in air quality of the analysis area would continue. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.4.4.2 Alternative 2 – MMC's Proposed Mine

3.4.4.2.1 Particulate Matter and Gaseous Pollutants

Pollutants emitted by the proposed project would be from fugitive sources such as haul roads, from mobile sources such as earth moving equipment, and from point sources such as generators. PM_{10} and NO_x would be the primary pollutants (Table 45).

Table 45. Total Air Emissions for Alternative 2.

Pollutant	Point Source Emissions (tpy)	Fugitive Emissions (tpy)	Mobile Source Emissions (tpy)
PM_{10}	12.7	138	5.07
$PM_{2.5}$	2.62	20.6	5.07
NO_x	3.60	1.33	163
SO_2	0.01	0.14	6.32
CO	0.47	64.7	56.6
Volatile organic compounds	0.13	0.00	9.01
Lead	0.0007	0.0014	<0.0001

tpy = tons per year.
Source: DEQ 2006.

Dispersion model results were compared to applicable ambient standards. Ambient background concentrations were added to modeled concentrations to obtain total concentrations for comparison to the NAAQS and MAAQS. Model results for all analyzed pollutants would comply with all NAAQS and MAAQS (Table 46).

Table 46. Maximum Concentrations During Operations in Alternative 2 Modeled with ISCST3 Compared to MAAQS and NAAQS.

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	Pollutant Background ($\mu g/m^3$)	Total Concentration (Modeled + Background) ($\mu g/m^3$)	MAAQS ($\mu g/m^3$)	% of MAAQS	NAAQS ($\mu g/m^3$)	% of NAAQS
PM_{10}	Annual	4.09	14	18.09	50	36.2	Revoked	—
	24-Hour†	21.66	35	56.66	150	37.8	150	37.8
$PM_{2.5}$	Annual	2.1	3.5	5.60	—	—	15	37.3
	24-Hour†	13.97	10.4	24.37	—	—	35	69.6
NO_x	Annual§§	19.8	6	25.8	94	27.5	100	25.8
	1-Hour§	364	75	439	564	77.8	—	—
SO_2	Annual	1.92	3	4.92	52	9.5	80	6.2
	24-Hour†	12.25	11	23.25	262	8.9	365	6.4
	3-Hour†	42.15	26	68.15	—	—	—	—
	1-Hour†	51.42	35	86.42	1,300	6.7	—	—
Lead	Quarterly*	0.00026	NA	0.00026	—	—	1.5	0.02
	90-day*	0.00026	NA	0.00026	1.5	0.02	—	—

†Concentrations are high second-high values. Certain ambient air quality standards are "not to be exceeded more than once per year." DEQ looks at the highest second high value for maximum modeled concentrations.
§The ozone limiting method has been applied to this result.
§§The ambient ratio method has been applied to this result.
*The 1-month average concentration is used for compliance demonstration.
NA = Not available.
$\mu g/m^3$ = microgram per cubic meter.
Source: DEQ 2006.

The Libby Loadout would be completely enclosed; no particulate emissions would occur from transfer, storage, or loading activities at the site (Figure 12). The transfer and loading of concentrate onto rail cars would be conducted within the pressurized load-out building. The concentrate would possess a high moisture content (16 percent to 20 percent), which would inherently control particulate emissions. Any product loss from trucks outside the load-out facility would be swept promptly. The complete enclosure of the handling and transfer operations within the pressurized building, combined with the other product loss control methods, is estimated to control emissions from the transfer and loading operations.

3.4.4.2.2 Application Scenario ISCST3 to AERMOD Results Comparison

Maximum modeled concentration impacts with the AERMOD model were less than previous ISCST3 results for all modeled pollutants and averaging periods. AERMOD-modeled impacts ranged from about 62 percent to 90 percent of the ISCST3 predicted concentrations when representative background values are included in the total concentrations (Table 47). All maximum modeled concentrations (with background) were below applicable NAAQS and MAAQS (Sage Environmental Consulting 2007).

For the receptors placed in the nearby CMW, AERMOD predicted concentrations for all pollutants and averaging periods that were below those predicted by ISCST3, with AERMOD-predicted values ranging from about 19 percent to 26 percent of those values predicted with ISCST3. All modeled concentrations were below applicable PSD Class I increments (Sage Environmental Consulting 2007). Implementation of Alternative 2 would not result in incremental concentration increases greater than PSD Class I increments within the CMW.

Table 47. ISCST3 and AERMOD Modeled Concentrations Plus Background Concentration for Alternative 2.

Pollutant	Averaging Period	Class II		Class I		Class I Increment
		3ISCST3	AERMOD	ISCST3	AERMOD	
		(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
PM_{10}	Annual	18.09	16.45	0.25	0.05	4.00
	24-Hour†	56.66	50.96	4.18	1.08	8.00
$PM_{2.5}$	Annual	5.60	4.72	—	—	—
	24-Hour†	24.37	18.17	—	—	—
NO_x	Annual	25.84	17.41	1.62	0.30	2.50
	1-Hour†	438.94	309.08	—	—	—
SO_2	Annual	4.92	4.18	0.10	0.02	2.00
	24-Hour†	23.25	18.52	2.24	0.55	5.00
	3-Hour†	68.15	42.27	7.97	1.83	25.00
	1-Hour†	86.42	56.35	—	—	—

†High 2nd high values.
µg/m^3 = microgram per cubic meter.
Source: Sage Environmental Consulting 2007.

3.4.4.2.3 Hazardous Air Pollutant Impact Assessment

Various metals would be present in ore, tailings, waste rock, concentrate, and road dust. Some of the metals are considered HAPs. Modeled concentrations of arsenic, cadmium, and chromium in

emissions were predicted to be above the DEQ's incinerator risk assessment levels, and these compounds were carried forward in the analysis. The Montanore Project proposed life is 16 years. The total combined cancer risk from these three metals was determined by summing the cancer risk of each metal using a 20-year exposure period and was found to be 1 in 1,000,000.

Potential air emissions of lead were modeled for the mine and reported in the air permit application (TRC Environmental Corp. 2006a). Emissions of lead, both a criteria pollutant and a HAP, were calculated based on preliminary ore assays conducted by Noranda (TRC Environmental Corp. 1989). Lead assays performed on the main ore body and on concentrate produced a mass fraction of lead in the analyzed material: 0.005 percent lead in ore and 0.44 percent lead in concentrate. Lead emissions are calculated as particulate emissions multiplied by the appropriate lead mass fraction. Predicted lead concentrations are below the NAAQS and MAAQS (Table 46) (TRC Environmental Corp. 2006a).

No relevant Montana risk assessment guidance exists; as a result, carcinogenic risk was calculated based on currently established unit risk factors for lifetime exposure as defined in the Integrated Risk Information System (IRIS) database (IRIS 2005). Predicted lead concentrations are well below the quarterly MAAQS; the maximum modeled concentration for lead is 0.00026 mg/m^3 at the north side of the Ramsey Plant Site boundary (receptor location) compared to 1.5 mg/m^3 MAAQS and NAAQS (or 0.2 percent of the standard). There is no IRIS Lifetime Cancer Risk Factor currently available for lead.

3.4.4.2.4 Construction Emissions

Construction activities would be temporary and would precede full production, which for modeling purposes, was assumed to be in Year 4. During the first phase of construction, underground construction activities would begin, no major surface construction activities would occur, and one 1,622 horsepower diesel electric generator (with one identical co-located unit on standby) would operate continuously at the Libby Adit to provide electrical power. The generator would operate until line power becomes available, which MMC expected to be less than 1 year from commencement of construction activities. After the Bear Creek Road underground electric line was installed, the generator would operate as an emergency backup only.

Dispersion modeling was performed for the first phase of construction, the only portion of construction during which a generator would operate continuously, to determine whether that construction activities would comply with ambient air quality standards. The maximum-modeled 1-hour NO_x concentration was 364 $\mu g/m^3$ and the maximum annual average NO_x concentration was 19.8 $\mu g/m^3$. Both concentrations are less than the MAAQS of 564 and 94 $\mu g/m^3$, respectively; there is no NAAQS for NO_x (TRC Environmental Corp. 2006a).

3.4.4.2.5 Non-attainment Area Boundary Impact Assessment

The concentrate loadout facility in Libby would emit no pollutants to the atmosphere because the surface moisture of the concentrate and all loading activities would be enclosed by a building (TRC Environmental Corp. 2006a). Covered trucks would transport the concentrate to the Libby Loadout, and then back on to a concrete covered pad and dump concentrate into the concentrate building. Control devices would be used to control fugitive dust associated with concentrate handling and loading. The rail car would be located inside an enclosed area as another means to control fugitive dust. The openings of the rail car loadout building would be covered with heavy plastic strips or other similar devices to effectively act as a door.

Modeled concentrations of PM_{10} and $PM_{2.5}$ from mine operations were calculated at receptors placed at regular intervals along each non-attainment area boundary, and were compared to EPA's proposed PSD Class II significance levels for PM_{10}. Significant impact levels have not been established by EPA for $PM_{2.5}$ non-attainment areas. Modeled concentrations were predicted to be less than PM_{10} significance levels, indicating that mine operations would not significantly affect PM_{10} concentrations within Libby's non-attainment areas (Table 48).

Table 48. Comparison of Non-attainment Area Modeled Concentrations under Alternative 2 to PSD Class II Significance Levels.

Non-attainment Area	Pollutant and Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	PSD Class II Significance Level ($\mu g/m^3$)
Libby, MT PM_{10}	PM_{10} Annual PM_{10} 24-Hour	0.042 0.83	1.0 5.0
Libby, MT $PM_{2.5}$	$PM_{2.5}$ Annual $PM_{2.5}$ 24-Hour	0.44 1.75	Not established

$\mu g/m^3$ = microgram per cubic meter.
Source: DEQ 2006.

3.4.4.2.6 Cabinet Mountain Wilderness Impact Assessment

An analysis of air quality impacts at and within the PSD Class I Area boundary was completed, and concentrations were compared to PSD Class I Increments that exist for PM_{10}, NO_x, and SO_2. Modeled concentrations were predicted to be less than PSD Class I Increments at all locations at and within the Class I Area boundary (Table 49).

Table 49. Modeled Concentrations in the CMW Compared to PSD Class I Increments.

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	PSD Class I Area Increment ($\mu g/m^3$)	% of PSD Class I Area Increment
PM_{10}	Annual	0.25	4	6.4
	24-Hour	4.18	8	52.2
NO_x	Annual	1.62	2.5	64.7
SO_2	Annual	0.10	2	5.1
	24-Hour	2.24	5	44.7
	3-Hour	7.97	25	31.9

$\mu g/m^3$ = microgram per cubic meter.
Source: TRC Environmental Corp. 2006a.

The Air Quality Related Values analysis included dispersion modeling to determine visibility impacts, and nitrogen and sulfur deposition impacts on CMW from mine operations (TRC Environmental Corp. 2006b).

Visibility Impact

Out of 1 year of hourly analyses, only 3 hours of potential plume impairment were found for each of the Ramsey Plant Site portal and the emergency generator at the Libby Adit. The emergency generator was modeled at maximum hourly emission rates year-round, although it is expected to be permitted to operate a maximum of 16 hours per year. The potential plume impairment hours would be just over the thresholds for color difference.

Contrast parameters were computed to be less than criteria set by EPA, indicating that there would be no perceptible contrast change or general haze in the CMW due to the mine. The reduction in visual range also was predicted to be below perceptible levels. Infrequent, episodic events, such as high winds causing erosion of the tailings impoundment surface could cause minor, short-term visual impacts from dust plumes that could be visible from the CMW and other areas.

Nitrogen and Sulfur Deposition

Maximum nitrogen deposition impacts from the mine were found to be greater than the USDI National Park Service deposition analysis threshold (DAT); maximum sulfur deposition impacts were found to be comparable to the DAT. All impacts were below the Forest Service levels of concern (TRC Environmental Corp. 2006b).

The computer model predicted annual deposition fluxes of sulfur and nitrogen at sensitive water bodies in the CMW. These were used to estimate the change in ANC of at each location. The predicted change in ANC for sulfur and nitrogen was compared with the Forest Service Level of Acceptable Change (LAC) thresholds of 10 percent for lakes with background ANC values greater than 25 µeq/l, and 1 µeq/l for lakes with background ANC values of 25 µeq/l or less. The predicted change in ANC was below applicable LAC thresholds at all lakes analyzed (Table 50) (TRC Environmental Corp. 2006b).

Table 50. Predicted ANC Change at Class I Sensitive Water Bodies.

Site	Background ANC (µeq/l)	Predicted Change in ANC (%)	Predicted Change in ANC (µeq/l)	LAC Threshold for ANC
Lower Libby Lake	12.6	NA	0.80	1 µeq/l
Upper Libby Lake	2.0	NA	0.87	1 µeq/l
Rock Creek	59.5	0.986	NA	10%

NA = Not applicable.
µeq/l = microequivalents/liter.
Source: TRC Environmental Corp. 2006b.

In summary, contrast parameters were computed to be less than criteria set by FLAG, indicating that there would be no perceptible contrast change or general haze in the CMW due to the project. The reduction in visual range also was predicted to be below perceptible levels. The predicted change in acid-neutralizing capability at sensitive lakes within the CMW is within the Forest Service LAC thresholds.

3.4.4.2.7 Best Available Control Technology Analysis

Emission controls to be used at the proposed project would constitute Best Available Control Technology (BACT), as required by ARM 17.8.752(1)(a). MMC would operate all equipment to provide for maximum air pollution control for which it was designed (TRC Environmental Corp. 2006a). Dust emissions from ore handling activities would be controlled with water sprays, wet Venturi scrubbers, baghouses, and enclosures. Ore grinding operations at the semi-autogenous grinding (SAG) mill would be fully enclosed and wet, with water pumped into the SAG mill at a rate of 7,780 gpm; therefore, the mill would not be a source of air emissions. Water sprays would be used, as needed, to prevent excess fugitive dust at the Little Cherry Creek Tailings Impoundment. Other proposed controls would be in compliance with BACT (DEQ 2006).

3.4.4.2.8 Odor and Noise

Odor and noise are not regulated in the ARM. Odor is a potential nuisance, but the project is not expected to increase odors. Noise is discussed in the subsequent section 3.19, *Sound, Electrical and Magnetic Fields, Radio and TV Effects*.

3.4.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The maximum modeled concentrations of applicable NAAQS and MAAQS plus background concentrations in the two ventilation scenarios were very similar to those for Alternative 2 with AERMOD (Table 51). Model results differ from the Alternative 2 results by less than 15 percent. Maximum modeled concentrations ranged from 4 percent to 63 percent of the applicable NAAQS and MAAQS depending on the pollutant analyzed and the averaging period. Maximum concentrations modeled within the CMW for this scenario showed compliance with all applicable Class I increments (Table 51) (Sage Environmental Consulting 2007).

The Poorman Tailings Impoundment Site is about 1 mile south of the Little Cherry Creek Tailings Impoundment Site. The same control measures would be used at the impoundment to control fugitive dust. Effects of the Poorman Tailings Impoundment would be similar to Alternative 2. If control measures were not successful, the potential for fugitive dust to reach private land not owned by MMC would be greater in Alternative 3 and than Alternatives 2 or 4. Construction emissions and effects on air quality in Libby would be the same as Alternative 2.

3.4.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would have essentially the same air emissions associated with underground exhaust and milling operations as Alternative 3. Concentrations of all pollutants would be below applicable standards. Effects from the tailings impoundment, road construction, and concentrate shipment would be the same as Alternative 2.

3.4.4.5 Alternative A—No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

Table 51. AERMOD Modeled Concentrations Plus Background Concentration for Alternatives 3 and 4.

Pollutant	Averaging Period	PSD Class II Area (outside Cabinet Mountains Wilderness)		PSD Class I Area (inside Cabinet Mountains Wilderness)		Class I Increment
		Libby Adits Only	Upper Libby Adit and Libby Adit	Libby Adits Only	Upper Libby Adit and Libby Adit	
PM_{10}	Annual	16.62	16.58	0.01	0.01	4.00
	24-Hour†	51.69	51.67	0.13	0.20	8.00
$PM_{2.5}$	Annual	4.82	4.79	—	—	—
	24-Hour†	18.52	18.51	—	—	—
NO_x	Annual	18.49	18.09	0.08	0.14	2.50
	1-Hour†	352.97	352.97	—	—	—
SO_2	Annual	4.26	4.25	0.003	0.003	2.00
	24-Hour†	18.94	18.94	0.06	0.05	5.00
	3-Hour†	45.35	45.35	0.28	0.27	25.00
	1-Hour†	57.95	57.95	—	—	—

†High 2nd high values.
All units are in $\mu g/m^3$ (microgram per cubic meter).
Source: Sage Environmental Consulting 2007.

3.4.4.6 Effects Common to Alternatives B, C, D, and E

Construction of all transmission line alternatives would result in short-term increases in gaseous and particulate emissions. Similar, but lower, emissions would occur at the end of operations when the transmission line is removed. Concentrations of criteria pollutants would not exceed NAAQS or MAAQS.

3.4.4.7 Cumulative Effects

With the exception of the Libby Loadout, past actions in the analysis area have had little effect on ambient air quality in the analysis area. Wood burning and other human activity at the Libby Loadout have increased concentrations of particulate matter and other gaseous pollutants. All action alternatives for the transmission line would have similar cumulative impacts. Of the reasonably foreseeable actions described in section 3.3, *Reasonably Foreseeable Future Actions*, the Rock Creek Project on the west side of the Cabinet Mountains in the Rock Creek drainage would contribute to the cumulative effect on air quality. The Rock Creek Project would have similar emissions sources associated with the plant site, tailings impoundment, and other surface disturbances as the Montanore Project. The project would use diesel equipment in the mine and vent mine exhaust northeast of the plant site. Although an intake ventilation adit would be located in the CMW, it would not be a source of emissions.

The impact analyses conducted for the Montanore Project predicted compliance with the Class I and Class II increments at the CMW boundary. The Montanore and Rock Creek Projects have been analyzed and found to have a potential minor impact on ambient air quality. The geographic areas of impact for each project do not overlap, and therefore would not be additive. Thus, cumulative air quality impacts would not exceed the NAAQS or MAAQS.

Acid deposition impacts at sensitive lakes within the CMW from the Montanore Project were calculated independently from the Montanore MAQP Application. According to the 1992 EIS, "NO_x and SO_2 increment consumption would occur from both projects (Rock Creek and Montanore), but the analysis indicates that there would not be a combined or overlapping increment consumption." This means that a small portion of the allowable increase in ambient air pollution concentrations under PSD Class I designations would occur as a result of each project. The increase would not be in the same geographic areas, and therefore would not be additive.

The Forest Service has monitored Libby Lakes for many years because of their high quality waters and sensitivity to change. There is concern that emissions from regional mining projects could increase acid deposition to the lakes, with acidification of the lake watershed and lake chemistry and associated adverse aquatic effects. The Forest Service conducted a MAGIC (Model of Acidification of Groundwater in Catchments) model screen analysis for CMW watersheds to determine the risk of both projects on Libby Lakes (Story 1997). The modeling results concluded the estimated changes in acid anions and base cations are not sufficient to project any changes in pH or alkalinity in Libby Lakes from either project directly, and cumulatively. The relatively low concentrations of emissions resulted in small changes in nitrogen and sulfur deposition to the Libby Lakes. The current estimated NO_x and SO_2 emissions from the Montanore Project (Table 49) are lower than the emissions used for the MAGIC model screen analysis. Therefore, the model results are very conservative.

The Forest Service MAGIC modeling is consistent with the AQRV Modeling Analysis Results that calculated maximum sulfur and nitrogen deposition impacts from sources of SO_2 and NO_x operating during Montanore Project production (TRC Environmental Corp. 2006b). Impacts were assessed at three sensitive water bodies identified by the DEQ: Lower Libby Lake, Upper Libby Lake, and Rock Creek. Deposition rates at these locations were used in ANC calculations and used as representative of the CMW for overall deposition analysis. Maximum nitrogen deposition impacts from the Montanore Project were found to be greater than the DAT [of NPS], and sulfur deposition impacts were found to be less or equal to DAT. All impacts were below the Forest Service levels of concern. The change in ANC is below applicable Forest Service LAC thresholds at all water bodies analyzed.

Timber harvesting, thinning, and prescribed burning associated with the proposed Miller-West Fisher Vegetation Management Project on unpaved roads would increase particulate emissions for a short duration. Concentrations of criteria pollutants would be well below the NAAQS and MAAQS. The cumulative effects of the two projects would not exceed the NAAQS and MAAQS. Other reasonably foreseeable actions in the area may be expected to contribute localized, short-term, and transient emissions of fugitive dust. The limited term nature of these potential emissions makes it unlikely that they would add measurably to emissions from the Montanore Project.

3.4.4.8 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the KFP and the Montana Clean Air Act because construction activities and facility operations in all alternatives would not result in exceedances of any NAAQS or MAAQS.

3.4.4.9 Irreversible and Irretrievable Commitments

During construction and operation of the project, air pollutant concentrations would be higher throughout the analysis area and in the CMW than current levels, but below applicable air quality standards. Following mine closure and successful reclamation, pollutant concentrations would return to pre-mining levels. There would be no long-term irreversible or irretrievable commitment of resources.

3.4.4.10 Short-term Uses and Long-term Productivity

During construction and operation of the project, air pollutant concentrations would be higher throughout the analysis area and in the CMW than current levels, but below applicable air quality standards. Once mining and reclamation are completed, the pollutant concentrations would return to pre-mining levels, assuming adequate revegetation success.

3.5 American Indian Consultation

Federal laws, regulations, and treaties direct the Forest Service to consult with federally recognized tribes who may have concerns about federal actions that may affect religious practice, traditional cultural uses, and cultural resource sites and remains associated with American Indian ancestors. The analysis area lies within the aboriginal territory of the Kootenai Tribe. The Confederated Salish and Kootenai Tribes (CSKT) and the Kootenai Tribe of Idaho (KTOI) are the federally recognized tribes representing the modern members of the Kootenai Tribe.

3.5.1 Regulatory Framework

The Forest Service has a government-to-government responsibility to all federally recognized tribes, as outlined in the Guide to USDA Programs for American Indians and Alaska Natives (USDA 1997a). American Indian tribes are afforded consideration under the National Historic Preservation Act (Section 2) (NHPA), NEPA, the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), and the Religious Freedom Restoration Act (RFRA), among other Executive orders and policy. Federal guidelines direct federal agencies to consult with modern American Indian tribal representatives and traditionalists who may have concerns regarding federal actions potentially affecting religious practices, and other traditional cultural uses. Consultation also may involve cultural resource sites and remains associated with American Indian heritage. Any tribe whose aboriginal territory falls within a analysis area is afforded the opportunity to voice concerns for issues governed by NHPA, NAGPRA, AIRFA, and RFRA.

AIRFA protects the “inherent right of the freedom to believe, express, and exercise their traditional religions” (P.L. 95-442, 92 Stat. 1065; 7 U.S.C. 2269). These concerns include, but are not limited to, access to sites, use and possession of sacred objects, and the freedom to practice sacred ceremonies. RFRA (P.L. 103-141) establishes a higher standard for justifying government actions that may impact religious liberties.

3.5.2 Treaty Rights

The analysis area is located within lands encompassed by the Hellgate Treaty of 1855. The Hellgate Treaty was signed between the United States and the Flathead, Upper Pend d’Oreilles, and the Kootenai Tribes, and the federal government has consultation responsibilities to ensure that the Tribes’ reserved rights are protected. The treaty-reserved rights include the “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 land”. The District fits the description of “usual and accustomed places,” and lies within the aboriginal territory of the Kootenai and the Salish (Flathead). Ongoing consultation with the CSKT ensures that tribal treaty rights are protected.

3.5.3 Analysis Area and Methods

The analysis area surrounds all mine facilities and the transmission line alternatives. Consultation with the KTOI and the CSKT has taken place from 1989 until present. In addition, the Coeur d’Alene and Kalispel Tribes were notified and an offer made for discussion about the project. The

KTOI responded to the request, and met for discussion. The Kalispel Tribe responded that due to the project being on the east side of the Cabinets, it was well outside of Kalispel aboriginal territory. They wanted to continue to receive correspondence about the project. The early consultation from 1989 to 1992 was conducted during the NEPA work associated with the original Montanore Project. While this Montanore Project EIS updates the NEPA work, the original Montanore Project EIS initially outlined the analysis area and therefore early consultation is relevant. The Montanore Project consultation resumed and extends from January of 2005 until present. The primary limitation of this analysis is dependent on the response received from the tribes. If the tribes decline to comment, then the information available for analysis is limited.

3.5.4 Affected Environment

3.5.4.1 Historical Tribal Distributions

Historically, the Kootenai Tribe was made up of seven bands, with four in Canada and three in the U.S. The three historic U.S. bands are: the Tobacco Plains Band, located around present-day Eureka, Montana; the Jennings Band, located around the confluence of the Kootenai and Fisher Rivers, and the Bonners Ferry Band, located around present-day Bonners Ferry, Idaho. The aboriginal territory of the bands of the Kootenai is an irregularly shaped parcel. The territory is bounded by a southeast-northwest line extending along the Continental Divide to the west side of Kootenay Lake in Canada. The boundary continues north of present-day Golden, British Columbia southward to the Clark Fork River, then follows eastward to the confluence of the Flathead and North Fork of the Flathead Rivers. In 1855, after U.S. negotiations with the Flathead (Salish), Upper Pend d'Oreilles, and the Kootenai Tribes, the Jennings and Tobacco Plains bands were moved to the Flathead Reservation and became known as the CSKT. The Bonners Ferry Kootenai did not sign the Hellgate Treaty and it was not until 1974 that the Tribe was deeded 12.5 acres of land north of Bonners Ferry, Idaho.

3.5.4.2 Consultation with Interested Tribes

Consultation with tribes was initiated during scoping for the Noranda Montanore Project. The CSKT indicated an interest in the project and on December 8, 1989, the cultural resource inventory report was sent to the CSKT for review (Historical Research Associates 1989a and 1989b). In 1990, the CSKT and KTOI responded by outlining general concerns. The KTOI referenced treaty rights associated with huckleberry gathering, big game hunting, and stream fishing (December 6, 1990). The CSKT also referenced treaty rights including water quality issues, fish habitat, and more specifically copper contaminant effects on sturgeon (December 11, 1990). Information addressing these issues was relayed by the Forest Service with continued correspondence through 1991. Tribal consultation resumed under MMC's Montanore Project, with letters to the Tribal Chairmen for the CSKT, KTOI, the Kalispel and Coeur d' Alene Tribes dated July 18, 2005. The Kalispel Tribe responded that the project was outside of their aboriginal territory and therefore did not request further consultation (September 17, 2005). The Coeur d'Alene Tribe did not respond with interest in the project. Numerous meetings with the CSKT and KTOI took place to answer tribal questions and requests for information sent by the Forest Service. Written correspondence from the CSKT requesting that no mining be permitted was received on July 5, 2006 and July 9, 2007. Detailed correspondence is located in either the project record for Mines Management's or Noranda's Montanore Projects. Both project records are located in the KNF Supervisor's Office.

3.5.5 Environmental Consequences

The lead agencies identified three scoping issues for tribal consultation: 1) rights under the Hellgate Treaty; 2) sacred places and access to those places for the exercise of religion; and 3) burials. The thresholds indicated by the three issues could not be measured, as the tribes have declined to provide the baseline data necessary to conduct effects analysis.

3.5.5.1 Alternative 1 – No Mine and Alternative A – No Transmission Line

In this alternative, no actions are proposed, and any previously recorded or as yet undiscovered cultural sites with Tribal affiliation would remain undisturbed. The CSKT letter dated July 5, 2006 conveyed the tribal perspective on the Montanore Project, "Throughout the consultation process the Kootenai Elders have expressed a general desire to see no mining permitted on the KNF. The Elders remain concerned with the potential impacts (both direct and indirect) to water quality, fisheries, wildlife, plant life, and non-renewable cultural resources. The Kootenai people have traditional stories, place names, and cultural history throughout the area of impact. The Elders have also noted the influx of mine employees, equipment, and other mine related activity could have an impact on Tribal use of this area." This position was affirmed in another memo dated July 11, 2006.

3.5.5.2 Effects Common to All Mine and Transmission Line Action Alternatives

While the tribes were afforded the opportunity to provide comments on all alternatives, they declined, stating that their opposition to the Mine negated the need to determine which alternatives were more preferable to them.

3.5.5.3 Cumulative Effects

The CSKT considered the effects of the Montanore Project and the Rock Creek Project as one. The CSKT submitted the following comment regarding the Montanore Project: "The expansion of the Montanore Mine has the potential to impact Tribal ancestral sites, including trails, fishing and gathering areas, as well as occupation sites. Both mines have the potential to degrade water quality, thus impacting aquatic habitats that provide Tribal members with traditional plants and medicines. The degradation of the surrounding watershed should have far-reaching impacts on culturally significant fish and wildlife, including the endangered bull trout and white sturgeon" (July 11, 2006). The CSKT have chosen not to identify specific effects as requested by the agencies, so the agencies cannot address specific direct or indirect impacts to these undisclosed cultural resources. Analysis of cumulative effects described in other resource sections indicates that increased access to the general project area could increase the use of treaty-related resources by the general public as well as tribal members. Vegetation removal as a result of construction of the proposed project or other permitted activities within the Libby Creek watershed could impact areas of potentially significant plant species associated with tribal use. These potential effects to resources identified by CSKT are outlined in the various resource sections in this document.

3.5.5.4 Regulatory/Forest Plan Consistency

The consultation process for this project is consistent with direction in the KFP, and all other laws and regulations described in the section 3.5.1, *Regulatory Framework*. The KNF has consulted with tribes when management activities may impact treaty rights and/or cultural sites and cultural use.

3.5.5.5 Irreversible and Irretrievable Commitments

The CSKT have stated their position that there would be irreversible and irretrievable impacts to non-renewable cultural resources. The specific resources referred to have not been disclosed to date.

3.6 Aquatic Life and Fisheries

This section describes changes to aquatic life and fisheries that may occur from the construction, operation, and reclamation of the Montanore Project. Existing conditions described in section 3.6.3, *Affected Environment* were determined through surveys and review of existing data sources and used to develop effects analysis for the fisheries resources in each watershed. Effects to fish populations were assessed based on effects to habitat.

3.6.1 Regulatory Framework

3.6.1.1 Endangered Species Act

The KNF is required by the ESA to ensure that any actions it approves will not jeopardize the continued existence of a T&E species or result in the destruction or adverse modification of critical habitat. Agencies are also required to develop and carry out conservation programs for these species. The KNF will prepare a biological assessment (BA) that evaluates the potential effect on T&E species that may be present in the area. The BA will include any measures the KNF believes are needed to minimize or compensate for adverse effects on listed species. The KNF will submit the BA to the USFWS for review and consultation and the USFWS will issue a BO. Section 1.6.1.2, *U.S. Fish and Wildlife Service* provides more information on the BO.

Bull trout (*Salvelinus confluentus*) is currently listed as threatened under the ESA and occurs within the analysis area. The USFWS has designated bull trout critical habitat in six streams in the analysis area: Rock Creek, East Fork Rock Creek, Libby Creek, Poorman Creek, Ramsey Creek, and West Fisher Creek. Bull trout is discussed in section 3.6.3.9, *Threatened and Endangered Fish Species.*

White sturgeon (*Acipenser transmontanus*) is currently listed as endangered and occurs in the Kootenai River. The white sturgeon is restricted to 168 miles of the Kootenai River between Cora Linn Dam in Canada and Kootenai Falls in Montana. All proposed activities are upstream of Kootenai Falls. The proposed Libby Loadout in a disturbed area of the Kootenai Business Park east of Libby is the closest project facility to the Kootenai Falls. The proposed activities would have no effect on white sturgeon or its habitat, and is not discussed further.

3.6.1.2 Major Facility Siting Act

The Major Facility Siting Act directs DEQ to approve a facility if, in conjunction with other findings, DEQ finds and determines that the facility minimizes adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives.

3.6.1.3 Montana Water Quality Act

The Water Quality Act is the primary statute for water quality protection in the State of Montana. The DEQ enforces the Act, and the Act also provides authority for the establishment of surface water and ground water standards, mixing zone rules, and nondegradation rules.

3.6.1.4 National Forest Management Act

The National Forest Management Act specifies that the National Forest System be managed to provide for diversity of plant and animal communities, based on the suitability and capability of the specific land area, in order to meet overall multiple-use objectives. Forest Service policy 9500-4 (FSM 2620.01) directs the Forest Service to: (1) manage "habitats for all existing native and desired non-native plant, fish and wildlife species in order to maintain at least viable populations of such species"; and (2) habitat must be provided for the number and distribution of reproductive individuals to ensure the continued existence of a species generally throughout its current geographic range.

The KFP (USDA Forest Service 1987) provides direction for meeting the requirements of the NFMA in its forest-wide goals and standards in chapter 1 (Volume 1) and in the Management Area (MA) direction in chapter III (Volume 1). The plan contains an overall forest-wide goal to provide sufficient quality and quantity of habitat for various species or groups of species within the suitability and capability of the forest to do so.

The KNF provides habitat for more than 300 different species of fish and wildlife (KIPZ Analysis of the Management Situation, USDA Forest Service 2003b: 45, 59-64), many of which occur on the Libby Ranger District and within the Montanore Project analysis area. The presence or absence of these fish and wildlife species depends on the amount, distribution, and quality of each species' preferred habitat. In addition to habitat changes, many of these are impacted by fishing, hunting or trapping. FWP regulates fish and game populations in the analysis area. The Forest Service and the FWP work together to ensure that an appropriate balance is maintained between habitat capability and population numbers. The Forest Service also works closely with the USFWS to assist in the recovery of species listed under the ESA. Proposed federal projects that have the potential to impact species protected by the ESA require consultation with the USFWS.

Sensitive species are managed under the authority of the NFMA and are administratively designated by the Regional Forester (FSM 2670.5). FSM 2672.42 directs the Forest Service to conduct a biological evaluation (BE) to analyze impacts on sensitive species. If any unmitigated, significant effects are identified in the BE, the Forest Supervisor must make a decision to allow or disallow the impact. If the significant effects would result in a significant trend toward federal listing, the Forest Supervisor cannot allow the project to proceed. The sensitive species analysis in this document meets the requirements for a BE as outlined in FSM 2672.42. Sensitive fish species identified within the analysis area are the interior redband trout (*Oncorhynchus mykiss gairdneri*) and the westslope cutthroat trout (*Oncorhynchus clarki lewisi*). Torrent sculpin (*Cottus rhotheus*) is a Species of Concern in the State of Montana, but no longer listed by Region 1 USDA Forest Service.

The KFP establishes forest-wide objectives, standards, guidelines, and monitoring requirements for KNF sensitive species. KFP direction for sensitive species includes determining the status of sensitive species and providing for their environmental needs as necessary to prevent them from becoming endangered.

3.6.1.5 Kootenai Forest Plan

The KFP established management areas within the forest with different goals and objectives based on the capabilities of lands within this area (USDA Forest Service 1987). In 1995, the KNF

amended the KFP to adopt the Inland Native Fish Strategy (INFS) (USDA Forest Service 1995). As part of this strategy, the Regional Foresters designated a network of priority watersheds, which are drainages that still contain excellent habitat or assemblages of native fish, provide for objectives of stable or increasing fish populations, or have excellent potential for restoration. The priority watersheds in the analysis area are Rock Creek, Bull River, West Fisher Creek, and Libby Creek. The area of Libby Creek designated as a priority watershed is Libby Creek and all tributaries upstream of U.S. 2.

To implement this strategy, INFS also established stream, wetland and landslide-prone area protection zones called Riparian Habitat Conservation Areas (RHCAs). INFS standards apply only to National Forest System lands. RHCAs are portions of watersheds where riparian-dependent resources receive primary emphasis. INFS sets standards and guidelines for managing activities that potentially affect conditions within the RHCAs, and for activities outside of RHCAs that potentially degrade RHCAs. These standards and guidelines are in addition to existing standards and guidelines in the KFP. RHCAs are defined for four categories of stream or water body, depending on flow conditions and presence of fish, with different RHCA widths for each category (Table 52). The widths shown in Table 52 are minimum widths. For fish-bearing streams, RHCAs extend from the edge of both sides of the active stream channel to the outer edges of the 100-year floodplain, to the outer edge of the riparian vegetation, to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet, include both sides of the stream channel), whichever is greatest. Widths of RHCA buffers are based on current scientific literature that documents them to be adequate to protect streams from non-channelized sediment inputs (sediment produced from overland flow) and provide for other riparian functions. These riparian functions include delivery of organic matter, large woody debris recruitment, and stream shading. All four categories are represented by streams and waterbodies in the analysis area.

Table 52. RHCA Categories and Standard Widths.

Stream or Waterbody Category	Standard Width
Fish-bearing streams	Minimum 300 feet each side of the stream
Perennial, non-fish bearing streams	Minimum 150 feet each side of stream
Ponds, lakes, and wetlands greater than 1 acre	Minimum 150 feet from maximum pool elevation
Intermittent and seasonally flowing streams, wetlands less than 1 acre, landslides and landslide prone areas	Minimum 50 feet from edge (except in priority watersheds, where the minimum is 100 feet)

Source: USDA Forest Service 1995.

In addition, INFS identifies riparian management objectives (RMOs) that guide management of key habitat variables for good fish habitat on National Forest System lands. The RMOs for stream channel conditions provide the criteria against which attainment or progress toward attainment of riparian goals is measured. RMOs, as established by INFS standards for forested systems, include pool frequency, large woody debris (LWD) frequency, and width/depth ratio (Table 53). Actions that retard attainment of these RMOs, whether existing conditions are better or worse than

objective values, are considered to be inconsistent with INFS and therefore not in compliance with the KFP.

Table 53. Habitat Measures associated with Riparian Management Objectives Standards.

Habitat Measure		Riparian Management Objectives Standard		
Bankfull Width (ft)	**Pools per Foot**	**Large Woody Debris per Foot (>BFW)**	**Bank Stability (%)**	**Width/Depth Ratio**
<10	1 per 55	1 per 250	>80	<10
10-20	1 per 94	1 per 250	>80	<10
20-25	1 per 112	1 per 250	>80	<10
25-50	1 per 203	1 per 250	>80	<10

BFW = Bankfull width.
Source: USDA Forest Service 1995.

INFS included project- and site-specific standards and guidelines that apply to all RHCAs on National Forest System lands and to projects and activities outside RHCAs on National Forest System lands that have the potential to degrade RHCAs. Some of the standards and guidelines require that activities not retard or prevent the attainment of the RMOs. “For the purposes of analysis, to ‘retard’ would mean to slow the rate of recovery below the near natural rate of recovery if no additional human-caused disturbance was placed on the system. This obviously will require professional judgment and should be based on watershed analysis of local conditions” (USDA Forest Service 1995). Section 3.6.4.11, *Regulatory/Forest Plan Consistency,* discusses compliance with the following RHCA standards and guidelines:

- Timber management (TM-1)
- Roads management (RF-2 through RF-5)
- Minerals management (MM-1, MM-2, MM-3, and MM-6)
- Lands (LH-3)
- General riparian area management (RA-2 through RA-4)
- Watershed and habitat restoration (WR-1)
- Fisheries and wildlife restoration (FW-1)

3.6.2 Analysis Area and Methods

3.6.2.1 Analysis Area

The analysis area includes areas where aquatic resources may be affected either by mine construction, operations, and closure or by construction, maintenance, and decommissioning of the transmission line. Mine alternatives may affect the named and unnamed streams in the East Fork Bull River, Rock Creek, Ramsey Creek, Poorman Creek, Bear Creek, Libby Creek, and

Little Cherry Creek watersheds. The transmission line corridor area is drained by the Fisher River and its tributaries: Hunter Creek, Sedlak Creek, Miller and North Fork Miller creeks, Standard Creek, and West Fisher Creek; and by Libby Creek and its tributaries: Howard Creek, Midas Creek, and Ramsey Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the analysis area. Short segments of the Miller and West Fisher Creek transmission line alternatives would be within the Standard Creek watershed, but the line and any associated access roads would be located more than 1 mile from the creek and not within any RHCA. No effects on Standard Creek are expected, and it is not discussed further. Only minor disturbance would occur in Midas Creek from the North Miller Creek and Modified North Miller Creek transmission line alternatives. Disturbance would be limited to the upper part of the watershed, would not occur within an RHCA, and would be unlikely to affect aquatic life. Thus, impacts in Midas Creek are not discussed in detail. Proposed activity in other watersheds would be minimal and would have no potential for adverse effects on fish species and other aquatic organisms; these watersheds are not discussed further in this section.

Lakes included in the analysis area are Rock Lake and St. Paul Lake (Figure 53). Libby Lakes are not expected to be affected by the proposed project and Ramsey Lake does not provide aquatic habitat; these lakes are not discussed further.

3.6.2.2 Baseline Data Collection

3.6.2.2.1 Data Sources

The FWP's Montana Fisheries Information System (MFISH) database (FWP 2008a) and the 1992 Montanore Project Final EIS (USDA Forest Service *et al.* 1992) were the primary sources used to determine fish distribution in the analysis area. The 1992 Final EIS also provided data on benthic macroinvertebrate and periphyton populations, as did additional surveys that were conducted at a limited number of sites in 1990 through 1994 as part of an interim monitoring program (Western Technology and Engineering 1992, 1993, 1994; Western Technology and Engineering and Phycologic 1995). Fish distribution surveys, fish genetic analyses, and habitat surveys have also been performed from before the initial baseline period up through 2005, mainly by the FWP. Results of most of these surveys were summarized by Kline Environmental Research (2004). Additional data were used from habitat and fish surveys conducted on the East Fork Bull River and Rock Creek between 1992 and 1994 (Washington Water Power Company 1996), and on the East Fork Bull River in 1999 (Chadwick Ecological Consultants, Inc. 2000). Annual data on fish distribution, abundance, spawning surveys, and aquatic habitat surveys have been gathered by Avista Corp. (Avista) in East Fork Bull River and Rock Creek drainages from 1999 to 2008 for their hydropower relicensing agreement (GEI 2005; Hintz and Lockard 2007; Horn and Tholl 2008; Lockard *et al.* 2008; Storaasli and Moran 2008). Descriptions and data for Rock Creek from the Rock Creek Project Final EIS were used (USDA Forest Service and DEQ 2001).

The most recent aquatic resources data used were from surveys conducted in 2005 to supplement the existing data. These data focused on fish distribution, habitat quality, location and navigability of culverts and other barriers, composition of spawning gravel, stream temperature, and the comparison of fish habitat quality in Little Cherry Creek and in the proposed drainage diversion (Kline Environmental Research 2005a, 2005b; Kline Environmental Research and Watershed Consulting 2005a, 2005b; Kline Environmental Research, ADC Services and Watershed

Consulting 2005; Watershed Consulting and Kline Environmental Research 2005). Additional data from Avista include data for the East Fork Bull River and Rock Creek through 2007.

3.6.2.2.2 Habitat Survey

During the initial baseline study period in 1988, physical habitat was evaluated at 18 stream reaches located on Libby, Little Cherry, Ramsey, Poorman, Bear, and East Fork Rock creeks. The habitat surveys classified stream reaches using the USDA Forest Service General Aquatic Wildlife System Level III assessment (USDA Forest Service 1989), which incorporates the Rosgen (1985) channel-typing system. This system categorizes reaches based on various measurements of entrenchment, width-to-depth ratio, sinuosity, substrate, and stream slope. The Forest Service also used this method to characterize a more limited number of reaches in these streams in 1997, 1998, 2002, 2004, and 2005 (Kline Environmental Research 2004; USDA Forest Service 2005).

Habitat surveys were conducted on Rock Creek and the East Fork Bull River between 1992 and 1994 (Washington Water Power Company 1996) as part of a survey of the lower Clark Fork River tributaries. Various habitat variables were recorded, including but not limited to: average widths, average depths, maximum pool depths, bank stability, substrate composition, amount of large woody debris, and percentage of surface fines. Temperature at the time of sampling was recorded and the spawning area substrate composition and spawning habitat availability were evaluated. The Lower Clark Fork Habitat Problem Assessment (GEI 2005) summarized habitat surveys in the East Fork Bull River from 1993 to 2003 and habitat work in Rock Creek. The Rock Creek Project Final EIS used these data and also summarized similar habitat data from additional sources (USDA Forest Service and DEQ 2001).

Stream habitat surveys also were conducted in the Libby Creek watershed in July and August 2005 during base flow conditions at most sites shown in Figure 53. Site LC4 was not surveyed because it had only isolated, shallow pools as habitat. Survey protocols followed USDA Forest Service Level III Region 1/Region 4 fish habitat inventory procedures (Overton *et al.* 1997), and are described by Watershed Consulting and Kline Environmental Research (2005). Habitat units at each site were identified, with various measures such as length, width, average and maximum depths, number of pools, pool type, substrate composition, percent stable and undercut banks, and amount of large, woody debris existing in the stream channel recorded for each unit.

A more extensive habitat survey was conducted in May and June 2005 for Little Cherry Creek and Channels A and B, proposed to receive flows of diverted Little Cherry Creek in Alternatives 2 and 4. Methods used to collect the data were generally based on Bain and Stevenson (1999), with aspects of the USDA Forest Service methods incorporated to address the biological and physical variables determined to be essential for bull trout (USDA Forest Service 1998b). This survey documented distance, elevation, macrohabitat type, pool dimensions, large woody debris, substrate, valley slope and width, and riparian characteristics continuously along the entire length of the creek. The five habitat characteristics that could be documented in Channels A and B (channel gradient, valley side gradient, flood prone width, riparian type, and large, woody debris) also were surveyed to allow for comparisons between what currently exists in Little Cherry Creek and what could be predicted to develop in the two channels (Kline Environmental Research 2005a).

Separate surveys were conducted that documented culverts and potential fish barriers in Libby Creek upstream of NFS road #231 (Libby Creek Road), and the full length of Little Cherry Creek, Poorman Creek, and Ramsey Creek (Kline Environmental Research 2005b; Kline Environmental Research *et al.* 2005). Culverts were surveyed and analyzed for their potential to block upstream passage of fish. All other fish barriers were photographed, described, and measured for breadth, height, and plunge pool depth. Once a permanent barrier to all fish under all flow conditions was identified on each tributary, the survey effort was discontinued. Kline Environmental Research (2005b) describes the methods used to characterize the barriers.

Stream gravel samples were collected from 15 sites on Libby, Little Cherry, Poorman, Bear, and Ramsey creeks using a McNeil core sampler (Kline Environmental Research and Watershed Consulting 2005b). Samples were collected in July and August 2005 from all locations shown in Figure 53, except for sites Be2, LC4, and L9. The sites on Bear Creek and Libby Creek were not sampled at that time because McNeil core samples had recently been collected in 2004 and 2005 by the FWP or USDA Forest Service at or near those locations (Wegner, pers. comm. 2006a). The upstream Little Cherry Creek site was not sampled for gravel because only isolated, shallow pools for fish were present at the site, and no fish were observed at the site immediately downstream. When sufficient quantities of gravel were present, 10 core samples were collected from each reach with the McNeil sampler. A more complete description of methods used to collect and process the gravel samples is given by Kline Environmental Research and Watershed Consulting (2005b).

The Fisher River was surveyed in 2003 and Miller Creek was surveyed in 1998 and 2005 by the KNF. These surveys provided information on Rosgen channel type, gradient, width/depth ratio, and substrate composition.

3.6.2.2.3 Periphyton Population Survey

Periphyton populations were sampled in analysis area streams during August 1988, October 1988, and April 1989 as part of the initial baseline study. Interim monitoring continued during 1990 and 1991 at all locations in the analysis area, and during 1993 and 1994 at Libby Creek sites only. The objective of the continued monitoring was to assess possible impacts of exploration activities during 1991 and elevated concentrations of nitrate in Libby Creek.

Collection of the samples involved scraping algae from a variety of substrates and combining those scrapings to compose one sample per site. Non-diatom algae were identified to genus, with relative abundances of each taxon estimated as rare, common, very common, abundant, or very abundant. Diatoms were identified to species, with percent relative abundances calculated when possible. Full descriptions of methods used for each sampling event are documented by Western Resource Development Corp. (1989a); Western Technology and Engineering (1992, 1993, 1994); and Western Technology and Engineering and Phycologic (1995).

3.6.2.2.4 Macroinvertebrate Population Survey

Stream macroinvertebrates were collected from 21 locations in analysis area streams between 1986 and 2004 (Western Resource Development Corp. 1989a; USDA Forest Service and DEQ 2001; Western Technology and Engineering 1991, 1992, 1993, 1994; Western Technology and Engineering and Phycologic 1995; Hoffman *et al.* 2002; Dunnigan *et al.* 2004; USDA Forest Service 2006). Some reaches were sampled up to 23 times over that time period. Sampling began

in 1988 in Libby Creek, Bear Creek, Little Cherry Creek, Poorman Creek, Ramsey Creek, and East Fork Rock Creek for the purpose of collecting the initial baseline data for the project. Interim sampling continued through 1994 at a more limited number of reaches in these streams to assess possible impacts of mining activities that occurred during 1991. Additional macroinvertebrate data were collected from a single reach in Libby Creek in 2000 and 2003 in order to evaluate the effects of a restoration project that was completed during that time period (Hoffman *et al.* 2002; Dunnigan *et al.* 2004). The KNF conducted sampling annually at four to six reaches on Libby Creek, Bear Creek, West Fisher Creek, and the Fisher River since 1998 (USDA Forest Service 2006). Macroinvertebrate sampling in East Fork Rock Creek occurred in 1986 through 1988 as part of the Rock Creek Project permitting.

Sampling methods differed over this time period in number of samples taken per site, type of equipment used to collect and process samples, and level of identification used for certain macroinvertebrate families. The differences in methods used complicate the ability to interpret any changes in population parameters over time.

3.6.2.2.5 Fish Population Survey

During 1988 and 1989, fish populations at 13 sites on Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, and the East Fork Rock Creek were sampled using backpack electrofishing equipment. Additionally, Rock Lake was sampled using gill nets and hook and line, and Rock Creek Meadows, a large wetland on East Fork Rock Creek below Rock Lake, was sampled using an electrofishing boat and hook and line. Sampling occurred in August and September 1988. Sites were generally between 330 to about 1,000 feet in length. Each fish collected was identified, weighed, and measured, and scales were taken from most fish to provide estimates of age and growth. Spawning was assessed from electrofishing results and from visual searches along Libby, Ramsey, and Poorman creeks conducted in October 1989.

Heavy metals analyses of rainbow trout (*Oncorhynchus mykiss*) tissues collected from the most downstream site on Libby Creek were conducted at Montana State University, Bozeman, and the Department of Health and Environmental Sciences, Helena, Montana (Western Resource Development Corp. 1989a).

Additional surveys have been conducted on analysis area streams and lakes by the FWP and others. The results of most of these surveys are summarized by Kline Environmental Research (2004), with additional survey results listed in the MFISH database (FWP 2008a). Fish population surveys also were conducted on the East Fork Bull River and Rock Creek between 1992 and 1994 (Washington Water Power Company 1996), and on the East Fork Bull River in 1999 (Chadwick Ecological Consultants, Inc. 2000) as part of projects surveying the lower Clark Fork River tributaries and the Bull River drainage. From 2000 through 2007, fish surveys were completed on the East Fork Bull River and from 2001 through 2007 on Rock Creek by Avista (Horn and Tholl 2008). Results of fish surveys conducted in Rock Creek from 1985 through 1996 and the results from metals analyses of trout tissue collected from Rock Creek in 1985 are summarized in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). As part of the mitigation efforts for the construction and operation of Libby Dam, fish population surveys also were conducted on Libby Creek from 2000 through 2004. Spawning surveys were conducted annually on Bear Creek from 1995 through 2004 as part of the same project (Dunnigan *et al.* 2004, 2005). During July and August 2005, day and night snorkel surveys were conducted at most 2005 sample

sites shown in Figure 53. Site LC4 was not surveyed because only shallow, isolated pools were present at that location, and because no fish were observed downstream at site LC3. Sites Be2, L9, L10, and L11 were not surveyed because fish surveys have been conducted near these reaches during 2003, 2004, or 2005 by government agencies (Kline Environmental Research and Watershed Consulting 2005a). Two of the Little Cherry Creek sites, sites LC1 and LC3, were too shallow for snorkeling, and were instead surveyed visually from the banks. For each macrohabitat type within each stream reach, counts of fish, species identifications, and lengths were documented to the extent practical without capturing fish. Kline Environmental Research and Watershed Consulting (2005a) provides a more complete description of methods used.

3.6.2.2.6 Riparian Habitat Conservation Areas and Other Riparian Areas

The KNF maintains a map of RHCAs for the Libby Ranger District, which is available in the agencies' project record. Most streams within the analysis area are considered fish-bearing streams under INFS. RHCAs also are found around wetlands (Table 52). Wetlands in the analysis area were "buffered" by the standard widths shown in Table 52 to generate a final RHCA and other riparian area map (Figure 54). Similar habitat is found on private land in the analysis area. Such habitat is described as "other riparian areas" in the impact assessment.

3.6.2.3 Impact Analysis Methods

The impact analysis methods focused on assessing the effects to fish, fish habitat, and other aquatic populations from the predicted changes in sedimentation rates, water quantity, water quality (nutrients and toxic metals), fish passage, and fish losses. Additionally, the effects of these changes on sensitive species, including threatened species and species of special concern, were assessed.

3.6.2.3.1 Sediment

Mine construction, mine activities, and transmission line construction may result in increased sediment in streams. Possible sources of sediment related to the proposed project were identified for the three phases of mine activities: construction, operation, and post-operation. The amount of sediment that may reach analysis area streams from these sources could not be quantified, but best professional judgment was used to assess the likely conditions under which sediments could be released into analysis area streams and the effects of these releases on stream habitat for each alternative. The possible changes to stream habitat that may occur from increased sedimentation rates were then evaluated as to their possible effect on fish and other aquatic populations within the analysis area.

3.6.2.3.2 Water Quantity

The water bodies in the study area include first-order headwater streams to larger second-order streams, as well as many glacial lakes whose water sources are snowmelt, rainfall, and ground water (hallow and deep). Streamflows are described in section 3.11, *Surface Water Hydrology*.

Continuous flow records are not available to adequately describe existing flow conditions or the range of natural variability in flow for any of the streams within the analysis area. The KNF maintains a continuous flow monitoring site on Libby Creek near U.S. 2, but it is outside of the analysis area. Only occasional flow measurements, summarized in Table 84, supplemented with calculated 7-day/10-year ($7Q_{10}$) flows for selected sites (see section 3.12.2.3.2, *Water Quantity* for $7Q_{10}$ discussion), were used to evaluate the effects of water quantity on fisheries habitat.

Section 3.10, *Ground Water Hydrology* describes how mine and adit inflows and the resulting ground water drawdown may impact base flow in streams that drain the mine area. Possible reduction in base flow is discussed in section 3.10.4, *Environmental Consequences*.

The analysis of changes in streamflow as a result of mining on fisheries habitat is a qualitative assessment based on best professional judgment and available data. Data to quantitatively assess or model changes in available habitat under existing and alternative flow conditions are not available. The analysis of flow-related habitat effects focuses on the threatened species, bull trout, but considers other species of concern (westslope cutthroat or interior redband trout) when needed. The basic assumption was made that reduced base flows potentially would have the greatest effect on bull trout populations by directly affecting their preferred spawning habitat. Similarly, any modest increase in base flows would benefit bull trout spawning habitat (see section 3.10, *Ground Water Hydrology* for discussion of base flow). Depending upon local conditions, bull trout generally spawn between September and October, in relatively deep gravel substrate that is heavily influenced by discharging ground water flow. Ground water seeps provide stable flow with consistent temperature regimes that are conducive for the 7- to 8-month egg-to-fry maturation cycle for bull trout (MBTRT 2000). Environmental factors that can affect the survival rate of bull trout eggs or fry include, but are not limited to, scouring due to high seasonal flows, freezing due to low flows, or sediment deposition. Sufficient deep ground water flow plays a pivotal role in the survival of bull trout eggs and fry development by mitigating these potential mortality factors (MBTRT 2000).

Basic descriptive statistics of the available measured and calculated flow ($7Q_{10}$), along with graphical presentations of measured flow, were examined for the critical flow period for bull trout (*i.e.*, the spawning period of September through October) to evaluate potential effects. The $7Q_{10}$ values were used in the habitat effect analysis because they approximate the worse case scenario given annual precipitation. Potential flow conditions during other times of the year were evaluated on a case by case basis depending upon available data.

Six possible mechanisms related to the mine operations may induce flow-related habitat changes. The first mechanism is effects to stream base flow due to mine and adit inflows. A second mechanism is related to the infiltration from the LAD Areas into the shallow ground water system and eventually into streams located downgradient. The third mechanism is related to the tailings impoundment, which would divert precipitation intercepted by the impoundment to the mill for subsequent reuse. Fourth, flow-related habitat changes may be affected by storm water runoff from the mine facilities. Fifth, make-up water may be needed if mine and adit inflows were not sufficient for mill operations. A sixth mechanism is that peak flow would be affected by vegetation clearing and road densities. None of the transmission line alternatives would affect streamflow.

3.6.2.3.3 Water Quality

Projected changes in water quality during low flow conditions and the three operation phases (construction, mining, and post-mining) were compared to existing median water quality concentrations at various locations on Ramsey Creek, Poorman Creek, Little Cherry Creek, and Libby Creek. Methods used in the mass balance calculations for prediction of water quality changes are discussed in section 3.12.2.3, *Impact Analysis*. It is unlikely that there would be any measurable change in the water quality of Rock Creek, the East Fork Bull River, or Libby Lakes.

Rock Lake and St. Paul Lake may become more dilute, with lower dissolved mineral concentrations (Gurrieri 2001).

Nutrients

The DEQ has not developed nutrient criteria recommendations for the protection of aquatic life applicable to the analysis area. Therefore, projected concentrations were compared to existing concentrations and the ecoregional reference condition established for nutrients by the EPA (Environmental Protection Agency 2000). The analysis area is located in nutrient ecoregion II, subecoregion 15, which has a reference condition of 0.2 mg/L for total nitrogen.

In 1992, the BHES issued an Order authorizing degradation and establishing allowable changes in surface and ground water quality adjacent to the Montanore Project for discharges from the project (BHES 1992). The Order established numeric nondegradation limits for total organic nitrogen as 1.0 mg/L total inorganic nitrogen (TIN) (see section 3.12.1.1.1, *Board of Health and Environmental Sciences Order No. 93-001-WQB*). In issuing the Order, the BHES determined that a limit of 1 mg/L TIN would be protective of all beneficial uses (BHES 1992). In 1992, the DHES (now DEQ) determined that land treatment would provide adequate secondary treatment of nitrate (80 percent removal). The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved and the TIN concentration in Libby, Ramsey, or Poorman creeks would not exceed 1 mg/L. The Order also adopted the modifications developed in Alternative 3, Option C, of the Final EIS (1992), addressing surface and ground water monitoring, fish tissue analysis, and instream biological monitoring. In all alternatives, the agencies assumed TIN concentrations (ammonia plus nitrate) could increase up to 1 mg/L. Existing TIN concentrations were not measured.

The greatest ecological effect of increased nutrient concentrations would be an increase in primary production potentially resulting in nuisance algal blooms either in the channel or downstream of the discharge. This analysis examined changes in nitrogen concentrations in the Libby Creek watershed, although nitrogen is only one of the factors that could influence production in the stream. Phosphorus is generally the limiting factor to production in this region and recent phosphorus data suggest low levels in the analysis area. Other factors, such as carbon, shading, stream velocity, and substrate composition can also limit algal production.

Ammonia is the only nutrient with known toxicity to aquatic life and has established aquatic life standards (ALS). Chronic criteria for ammonia are modified by ambient pH and temperature, and take into consideration the presence of sensitive early life stage fish. The presence of early life stage fish requires a more restrictive standard. Higher temperatures also result in a more restrictive standard. For an effects evaluation, projected changes in ammonia concentrations were compared to the chronic early life stage present criterion at ambient pH and temperature of 14˚C.

To evaluate the magnitude of change in nutrient concentrations, an enrichment ratio (ER) was calculated for each parameter as the projected concentration divided by the existing concentration. An ER equal to one indicates no expected change in concentration, less than one indicates an expected decrease in concentration, and greater than one indicates an expected increase in concentration. Only minor differences in nutrient concentrations would be expected during the three phases of operation; predicted impacts are discussed collectively.

Metals

Existing baseline and projected concentrations were available for total dissolved solids and several metals. The impact assessment for aquatic life focuses on two metals: copper and zinc. Copper and zinc are the focus of the aquatic life assessment because they have nondegradation limits set by the BHES Order, are found more frequently in area streams at concentrations above the detection limit, and would be in concentrations above the detection limit in discharged wastewater. Manganese was not included in the assessment, although it does have a BHES Order nondegradation limit in surface water. The BHES Order nondegradation limit of 0.05 mg/L in surface water was consistent with the Montana surface water quality standard in effect in 1992. Montana's surface water standard for manganese was designed to protect the beneficial use of surface water as a drinking water source. Manganese in drinking water can have adverse staining and taste characteristics. Montana currently does not have a surface water quality standard for manganese, nor an aquatic life standard (Table 94). The hardness-modified manganese standard of 1.04 mg/L for aquatic life adopted by Colorado (Stubblefield and Hockett 2000) was used to evaluate potential effects of projected manganese concentrations, which is a better indicator of potential harm to aquatic life than the BHES Order nondegradation limit of 0.05 mg/L. Manganese concentrations in surface water in all alternatives would be well below Colorado's standard protective of aquatic life and manganese is not discussed further.

Although monitoring would be required for a full suite of metals (see Appendix C), accurate predictions of instream concentrations of other metals resulting from Montanore discharges and the effect on aquatic life cannot be made. The other metal concentrations, in both receiving streams and in wastewater to be discharged, are frequently below the detection limit. The uncertainties associated with projected instream concentrations resulting from Montanore discharges are discussed in section 3.12.2.4, *Uncertainties Associated with the Water Quality Assessment*.

To determine potential effects of changes in copper and zinc concentration to aquatic life, projected instream concentrations for each alternative were compared to Montana numeric ALS (DEQ 2006b). The most current Montana ALS were used for comparisons (DEQ 2008a). Montana ALS for copper and zinc are stream hardness-modified values. Because the toxicity-hardness relationship is uncertain at hardness concentrations of less than 25 mg/L, a hardness value of 25 mg/L as $CaCO_3$ is used to calculate metals standards when ambient hardness is less than 25 mg/L (DEQ 2006b). Ambient hardness is less than 10 mg/L in many of the water quality monitoring locations, creating additional uncertainty for the analysis of effects of metals on fish. Existing metals concentrations are presented as total recoverable metal and, therefore, were compared to total metal standards when available.

Similar to the nutrient evaluations, ERs were determined for copper and zinc to quantify the magnitude of change from existing conditions to the projected concentrations. Only minor differences in metals concentrations would be expected during the three phases of operation; therefore, predicted impacts are discussed collectively.

3.6.2.3.4 Toxic Metals in Fish

Metal concentrations in fish tissues were determined from rainbow trout samples collected from Libby Creek downstream of the Little Cherry Creek confluence (Western Resource Development Corp. 1989a). Metals measured included cobalt, copper, lead, mercury, and zinc in fish ranging

from 3 inches to greater than 7 inches. All reported concentrations were assumed to be reported as wet weight. Potential changes in tissue concentrations for each alternative were not calculated due to the lack of information needed to determine site-specific bioaccumulation and bioconcentration factors. Rather, effects due to an increase in metal tissue concentrations were evaluated through projected changes for instream metals concentrations.

3.6.2.3.5 Fish Passage and Fish Loss

Mine activities have the potential for altering stream habitat by the creation of barriers to fish passage. If fish passage is restricted, habitat may be fragmented, migratory corridors may be eliminated, and fish subpopulations can become isolated from the remainder of the population. If a fish population becomes isolated, neighboring populations may be unable to recolonize and act as a source of gene flow for the isolated population, leaving it more vulnerable to extirpation. In several Montana watersheds, lack of connectivity has been identified as a major threat to bull trout restoration and persistence (Parametrix 2005). The likelihood that physical or flow barriers would develop in the analysis area and the potential effects of the development of those barriers were assessed using best professional judgment. Additionally, mine actions and mitigation plans were evaluated with respect to their potential to cause loss of fish within the analysis area.

3.6.2.3.6 Threatened, Endangered, or Sensitive Species

As part of the impact analysis, activities during mine construction, operation, and post-operation were evaluated to determine their potential to alter stream habitat in such a way as to adversely affect sensitive species. Threatened, endangered, or sensitive fish species include the bull trout, a federally listed threatened species, and interior redband trout and westslope cutthroat trout, all of which are species of special concern in Montana. Trout have specific habitat requirements for spawning, egg incubation, and rearing of juvenile fish, and possible effects on habitat must be assessed for all life stages. Best professional judgment was used to determine the potential for any adverse effects of mine activities to occur.

3.6.3 Affected Environment

3.6.3.1 Habitat

3.6.3.1.1 Stream Habitat Characteristics

Fish habitat parameters for 15 stream reaches within the analysis area sampled in 2005 are summarized in Table 54, with more detailed data summaries provided by Watershed Consulting and Kline Environmental Research (2005). Additional data from the KNF on Libby Creek and its tributaries are presented in Table 55. The habitat evaluations conducted in Libby Creek, Bear Creek, Little Cherry Creek, Poorman Creek, Ramsey Creek, and East Rock Creek during the initial baseline study period in 1988-1989 classified each stream reach using the Rosgen (1985, 1996) system. Figure 55 shows the Rosgen categories assigned to each reach during the initial baseline surveys and additional studies. If the same reach was surveyed for two or more years, then the category assigned to that reach during the most recent survey is given.

Table 54. 2005 Region 1/Region 4 Summary Data for 15 Stream Reaches.

Site	Study Length (ft)	Gradient (%)	Width/ Depth Ratio	Percent Riffle	Per-cent Run/ Glide	Per-cent Pool	Pools/ mile	LWD/ mile	Per-cent Stable Banks	Percent Undercut Banks
Libby Creek										
L1	997	1.8	50.9	48.3	28.1	28.6	10.3	31.9	100.0	0.0
L2	928	1.5	104.7	52.0	23.2	24.8	4.4	22.8	100.0	0.2
L3	1000	3.5	39.4	64.2	20.2	15.6	12.2	153.0	100.0	2.8
L9	1000	1.5	48.1	56.8	24.3	18.9	10.2	126.8	100.0	0.0
L10	1000	4.0	39.4	70.6	9.8	16.4	12.2	73.9	100.0	0.2
L11	1000	15.0	27.7	69.9	9.5	12.0	10.2	26.4	100.0	0.0
Bear Creek										
Be2	1066	2.0	32.9	77.7	6.1	16.2	11.5	153.5	99.7	0.1
Little Cherry Creek										
LC1	902	1.5	32.1	49.2	27.4	23.5	24.9	177.2	100.0	0.1
LC2	971	2.0	28.2	46.1	26.6	27.3	35.7	184.9	99.6	6.3
LC3	984	6.5	31.6	65.7	15.9	18.3	33.1	337.6	100.0	1.3
Poorman Creek										
Po1	1000	3.0	33.3	56.9	27.5	15.6	10.2	163.6	100.0	0.9
Po2	1000	6.0	42.5	66.3	4.2	27.9	24.5	105.6	100.0	1.3
Ramsey Creek										
Ra2	997	3.0	55.6	67.7	9.0	23.3	20.4	116.3	99.3	2.1
Ra3	1000	9.0	52.5	42.1	3.2	17.9	18.3	131.9	100.0	0.0
Ra4	1000	2.5	52.9	49.8	39.8	10.4	6.1	205.8	100.0	0.0

LWD = large woody debris.
Source: Watershed Consulting and Kline Environmental Research 2005.

Table 55. Stream Geomorphology Data for Libby Creek and Tributaries.

Site and Year Sampled	Rosgen Type	BFW (ft)	Pools/ft	LWD/ft	Per-cent Bank Stability	Width/ Depth Ratio
7 Libby 2005	D4	322	1/1,110	1/347	68	120
8 Libby 2005	F3	55	1/1,222	1/203	100	47.8
9 Libby 2005	B3c	39	1/797	1/80	100	34.7
10 Libby 1997	B3c	49.7	1/180	1/25	100	22.7
10 Libby 2004	F3	37.4	1/279	1/70	79	35.1
11 Libby 1997	B3c	44.9	1/225	1/450	100	32.9
11.5 Libby 2004	B2a	33.3	1/223	1/335	77	76.6
12 Libby 1997	C4	36.7	1/249	1/23	95	19.4
12 Libby 2004	C3	27.8	1/5	1/50	100	57
13 Libby 1997	C3	27.9	1/141	1/37	96.5	19.7
13 Libby 2004	F3	28.6	1/192	1/36	100	43.4
14 Libby 1997	B3c	35.8	1/144	1/23	91	24.5
15 Libby 1997	F3b	23.4	1/165	1/247	100	16.6
15 Libby 2004	B3	23.8	1/127	1/85	100	28.2
16 Libby 1997	B3c	34.8	1/357	1/48	100	26
16 Libby 2004	F4b	24.3	1/173	1/11	100	38.3
17 Libby 1997	C3b	31.9	1/192	1/36	100	43.4
17 Libby 2004	B3c	22.2	1/117	1/6	100	110.4
1 Little Cherry 1997	F4b	11	1/37	1/16	91	19.8
1 Midas 1998	B4	12.6	1/50	1/10	100	14.2
2 Midas 1998	F4b	11.8	1/34	1/19	100	18.8
3 Midas 1998	F3b	7.8	1/31	1/16	100	17
4 Midas 1998	B4	7.8	1/21	1/15	100	12.2
1 Poorman 1997	B2a	16	1/40	1/108	100	18.1
2 Poorman 1997	F3b	23.7	1/13	1/13	100	15.3
2 Ramsey 1997	B2c	15.2	1/31	1/22	100	18.1
1 Ramsey 1998	B3	22.5	1/7	1/16	100	17.5
1 Bear 2004	B3c	19.6	1/100	1/19	100	22.37
4 Bear2002	G4	16.82	1/121	1/18	100	1.14
2 Bear 2003	F3b	24.7	1/620	1/44	17	44.1
1 Bear 1997	B3c	25.2	1/127	1/63	100	24.9
1 Bear 2003	B3c	25.2	1/127	1/63	100	24.9
3 Bear 1997	F3	33.4	1/134	1/37	100	1.41
2 Bear 1997	B3c	32.8	1/111	1/21	100	31.4
3 Bear 2004	F3	26.8	1/50	1/35	100	15.5

Shaded values indicate RMOs or goals not met.
LWD = large woody debris; BFW = bankfull width.
Source: Libby Ranger District files 2007.

Three habitat indices also were calculated as part of the 1988-1989 habitat evaluations (Western Resource Development Corp. 1989a). The riparian habitat condition index is calculated based on nine vegetation and substrate measures, with the overall value ranging from 0 to 36. All values above 30 indicate excellent riparian habitat in the analysis area, with values between 22 and 30 indicating good riparian habitat. Based on this index, riparian habitat was good or excellent throughout most stream reaches (Table 56).

The habitat vulnerability index rates sites for potential susceptibility to aquatic habitat degradation based on measures of valley bottom width, stream gradient, upper bank slope, lower bank slope, bank stability, and indications of sediment production. Scores greater than 60 indicate high vulnerability to degradation. Scores between 45 and 60 indicate moderate vulnerability to degradation. Scores less than 45 indicate low vulnerability to degradation. Most streams in the analysis area had a moderate vulnerability (Table 56).

The habitat condition index measures potential fishery habitat. It ranges from 0 to 100, with higher scores indicating higher quality of habitat. Overall, the analysis area scored high on measures such as bank cover and stability, while measures of pool quality and quantity were typically lower, resulting in an overall reduction in stream reach scores (Table 56).

As an additional part of the baseline habitat surveys conducted in 1988 and 1989 (Western Resource Development Corp. 1989a), the percentage of potential spawning and rearing areas for fish was estimated for each reach of East Fork Rock Creek and the streams within the Libby Creek watershed.

The composition of spawning gravel was sampled with a McNeil core sampler from 15 stream reaches in Libby Creek, Little Cherry Creek, Ramsey Creek, Poorman Creek, and Bear Creek in 2005 (Table 57; Kline Environmental Research and Watershed Consulting 2005b; Wegner, pers. comm. 2006a). Additionally, a single site was surveyed on Rock Creek and three sites on the East Fork Bull River between 1992 and 1994 using similar sampling methods (Washington Water Power Company 1996). Samples were collected from sites that appeared most suitable for spawning. In the laboratory, samples were dried and sieved. Imhoff cones were used in the field to estimate fine sediment not accounted for in the McNeil core samples. This aspect of the stream habitat is important as the proportion of fine sediment in spawning gravel can be a limiting factor to the reproductive success of bull trout and other salmonids that deposit eggs in the stream gravel.

Generally, core samples showed that the upstream sites had a higher percentage of fine sediment and a smaller median substrate size in comparison to the downstream sites (Table 57). The most downstream reach on Libby Creek had the lowest percent fine sediment (14.6 percent), while the site sampled on Rock Creek (RC2) had the highest percent fine sediment (43.0 percent) (Kline Environmental Research and Watershed Consulting 2005b).

Libby Creek

The riparian habitat condition index, rated as fair throughout the reach of Libby Creek downstream of the Poorman Creek confluence (Site L4), reflects the physical effects of abandoned placer mining operations. All other reaches were rated excellent or good. The mean habitat vulnerability index was rated moderate for all sites.

Table 56. Mean Habitat Values for Analysis Streams in 1988-1989.

Site	Mean Riparian Habitat Condition Index	Mean Habitat Vulnerability Index	Mean Habitat Condition Index	Potential Spawning Area (%)	Potential Rearing Area (%)
Libby Creek					
L1	33/Excellent	55.45/Moderate	74.1	44.6	7.7
L2	33/Excellent	55.61/Moderate	75.5	25.0	16.8
L4	18/Fair	48.79/Moderate	55.4	34.2	21.7
L5	29/Good	43.94/Moderate	66.8	26.2	18.2
L8	25/Good	44.70/Moderate	70.1	36.6	39.2
L10	33/Excellent	52.73/Moderate	70.6	26.7	20.6
L11	32/Excellent	55.91/Moderate	80.0	33.8	28.6
Bear Creek					
Be1	29/Good	44.55/Moderate	73.2	29.1	25.1
Be2	31/Excellent	57.73/Moderate	78.6	37.6	31.6
Be3	30/Excellent	61.97/High	77.7	22.7	28.4
Little Cherry Creek					
LC1	33/Excellent	52.88/Moderate	65.9	25.2	17.8
Poorman Creek					
Po0	32/Excellent	45.76/Moderate	60.4	35.2	8.0
Ramsey Creek					
Ra2a	31/Excellent	58.94/Moderate	72	29.1	13.3
Ra3	32/Excellent	58.03/Moderate	65.4	18.6	21.9
Ra4	31/Excellent	60.45/High	50.9	4.4	99.0
East Fork Rock Creek					
Ro1	33/Excellent	59.24/Moderate	75.4	5.7	34.2
Ro3	29/Good	63.03/High	60.6	3.6	91.1
Ro4	30/Excellent	53.18/Moderate	61.1	2.3	34.4

Source: Western Resource Development Corp. 1989a.

Table 57. Mean Particle Size Distribution of McNeil Core Samples for Sites within the Analysis Area.

Site	Mean Particle Size (mm)	Mean % fine sediment (<6.25 mm)
Libby Creek		
L1	37.6	14.6
L2	26.6	19.6
L3	24.2	25.0
L9[†]	19.0	29.0
L10	25.8	21.7
L11	23.9	19.7
Little Cherry Creek		
LC1	24.5	19.5
LC2	18.5	23.9
LC3	35.3	39.4
Poorman Creek		
Po1	28.0	17.2
Po2	22.8	21.0
Ramsey Creek		
Ra2	33.4	14.8
Ra3	23.6	22.2
Ra4	23.0	23.1
Bear Creek		
Be2[†]	25.0	23.0
Rock Creek		
Ro1	Not Calculated	43.0
East Fork Bull River		
EFBR1	Not Calculated	25.0
EFBR2	Not Calculated	33.0
EFBR3	Not Calculated	15.0

[†]Sites were surveyed in 2005 by Libby Ranger District; data from other years also available.
mm = millimeter.
Source: Kline Environmental Research and Watershed Consulting 2005b.

The most likely locations for spawning in Libby Creek included the reaches downstream from its confluence with Bear Creek (Site L1), near its confluence with Poorman Creek (Site L4), downstream from Ramsey Creek (Site L5), and downstream from Howard Creek (Site L8).

Potential spawning habitat ranged from 25 to 45 percent of the total length of each surveyed reach in Libby Creek, and potential rearing areas ranged from 8 to 39 percent (Table 56).

In 2001, sections of Libby Creek were restored by the FWP. This project was implemented because accelerated bank erosion along some meander bends had resulted in a widened, shallow, and unstable stream channel that produced low quality habitat for native trout (Dunnigan *et al.* 2004). A part of the restoration focused on 1,700 feet of the stream located above the confluence of Elliot Creek with Libby Creek. Two eroding banks in this area were contributing substantial amounts of sediment to Libby Creek. The project restored this reach of Libby Creek, reduced bank erosion, and increased the quantity and quality of rearing habitat for native salmonids (Dunnigan *et al.* 2005). A second restoration project, designated the upper Cleveland restoration project, focused on about 3,200 feet of Libby Creek between the confluences of Howard Creek and Ramsey Creek. The restoration effort was aimed at increasing sinuosity (and thereby stream length) and the number of pools within the stream channel. The project additionally added cobble structures, rootwad complexes, and rock vanes to increase gradient control, pool habitat, and bank protection. Various shrubs, willows, and cottonwoods were planted to establish a healthy riparian area (Dunnigan *et al.* 2004). Much of this habitat restoration work was destroyed or damaged during a spring 2007 rain-on-snow effect, so current habitat conditions may not reflect these improvements. Rain-on-snow events occur with sufficient frequency to make habitat improvements in Libby Creek difficult to maintain.

Overall, the Libby Creek stream reaches were dominated by riffle habitat, with stable banks and good cover for fish (Table 54). All reaches were moderate in gradient (≤ 4 percent), except the most upstream reach. The dominant substrate types at all reaches were gravel and cobble (Watershed Consulting and Kline Environmental Research 2005).

Bear Creek

The mean riparian habitat condition index for Bear Creek was good in the upper reach and excellent in the two lower reaches. Based on the mean scores for each reach, the upper reach of Bear Creek was rated as having a potentially high vulnerability to degradation (Table 56). Other reaches of Bear Creek were rated as having moderate potential vulnerability to degradation (Western Resource Development Corp. 1989a).

Probable spawning areas include reaches in Bear Creek both downstream and upstream of Bear Creek Road (NFS road #278). Potential spawning habitat ranged from 23 to 38 percent in the surveyed reaches of Bear Creek, and potential rearing areas ranged from 25 to 32 percent (Table 56).

Bear Creek was also dominated by riffle habitat, had stable banks and the gradient at Site Be2 was 2.0 percent (Table 54). The dominant substrate types were cobble and gravel. The single reach surveyed on Bear Creek was noted as having good over-wintering and juvenile salmonid rearing habitat, although it appeared to provide limited spawning habitat.

Little Cherry Creek

The riparian habitat condition index for Little Cherry Creek was rated as excellent. The habitat vulnerability index was rated as moderate (Table 56). Potential spawning habitat was 25 percent in the surveyed reach of Little Cherry Creek, and potential rearing area was 18 percent (Table 56).

The stream reaches surveyed in the Little Cherry Creek were dominated by riffle habitat and had stable banks. Gradient was moderate to fairly steep (Table 54). The dominant substrate types at all reaches were cobble and gravel.

The upstream Little Cherry Creek site provided limited winter habitat availability and poor pool habitat. Although a few larger pools did exist in the middle reach of Little Cherry Creek, overall this reach also provided poor pool habitat, and little fish cover. The most downstream Little Cherry Creek reach had high habitat diversity, but low base flow water volumes.

Poorman Creek

The riparian habitat condition index for Poorman Creek was rated as excellent. The habitat vulnerability index was rated as moderate. Potential spawning area was found in the reach of Poorman Creek above its confluence with Libby Creek. Potential spawning habitat was 35 percent in the surveyed reach of Poorman Creek, and potential rearing area was 8 percent (Table 56).

The stream reaches surveyed in Poorman Creek were dominated by riffle habitat and had stable banks. Gradient was 3 percent in the upper reach and 6 percent in the lower reach (Table 54). The dominant substrate types at all reaches were cobble and gravel.

The downstream reach on Poorman Creek was braided, with much of the side channel water going subsurface before re-entering the main channel. The upstream Poorman Creek reach had high quality pocket pool habitat formed by cobble and small boulders that serve as good interstitial habitat for juvenile bull trout.

Ramsey Creek

The riparian habitat condition index was rated as excellent for all reaches of Ramsey Creek. Based on the mean scores for each reach, the upper reach of Ramsey Creek was rated as having a potentially high vulnerability to degradation (Table 56). The other reaches were rated as having moderate potential vulnerability to degradation (Western Resource Development Corp. 1989a).

Potential spawning habitat ranged from 4 to 29 percent in the surveyed reaches of Ramsey Creek, and potential rearing areas ranged from 13 to 99 percent (Table 56).

The stream reaches surveyed in Ramsey Creek were dominated by riffle habitat and had stable banks. Gradient ranged from 2.5 to 9 percent (Table 54). The dominant substrate types at all reaches were cobble and gravel.

The two downstream reaches on Ramsey Creek had a high amount of pool habitat. The farthest downstream Ramsey Creek reach had the highest amount of fish cover in Ramsey Creek, with larger pools that could offer winter fish habitat and a moderate amount of spawning gravel. The upstream Ramsey Creek reach had the lowest percentage of pool habitat out of all of the project stream reaches (Watershed Consulting and Kline Environmental Research 2005).

East Fork Rock Creek

The riparian habitat condition index was rated as good in the middle reach and excellent in the upstream and downstream reaches. The middle reach of East Fork Rock Creek was rated as having a potentially high vulnerability to degradation (Table 56). The other reaches were rated as

having moderate potential vulnerability to degradation (Western Resource Development Corp. 1989a).

Fish habitat was surveyed in four reaches of Rock Creek between 1992 and 1994 as part of a survey of the tributaries of the lower Clark Fork River (Washington Water Power Company 1996). The upstream reach was in East Fork Rock Creek, and was similar in location to the sites surveyed during the previous baseline surveys conducted there. Rock Creek was described as consisting of mainly run, low gradient riffle, and cascade habitat types, with substrate that was predominately rubble, cobble, gravel, and boulder. Other than the low gradient section termed Rock Creek Meadows, the reach on East Fork Rock Creek was composed primarily of cascade habitat, with a higher percentage of larger substrate such as boulder and cobbles present. Surface fines averaged 10 percent, and ranged from less than 1 to 22 percent. Generally the downstream reaches on Rock Creek contained lower amounts of large woody debris than the upstream reaches. Stream banks were relatively stable throughout Rock Creek, with some channel braiding. Substantial portions of the two downstream reaches have seasonally intermittent flows (Washington Water Power Company 1996; USDA Forest Service and DEQ 2001).

Potential spawning habitat ranged from 2 to 6 percent in the surveyed reaches of East Fork Rock Creek, and potential rearing areas ranged from 34 to 91 percent (Table 56). While each reach was not evaluated, the potential spawning and rearing areas for the stream as a whole also were estimated for Rock Creek in 1992 to 1994 (Washington Water Power Company 1996). The percentage of potential spawning habitat in Rock Creek was 1.1 percent. The percentage of potential rearing habitat in this stream was 16.1 percent. When compared to other tributaries to the lower Clark Fork River, the percentage of potential spawning area was relatively low, while the percentage of rearing habitat in Rock Creek was similar to other streams.

East Fork Bull River

As part of the fish habitat survey between 1992 and 1994 (Washington Water Power Company 1996), three reaches of the East Fork Bull River were surveyed. The habitat in this stream consists primarily of high gradient riffle and pool habitat types, with mainly cobble and rubble substrate in the high gradient sections and sand and silt in low gradient sections. East Fork Bull River had lower amounts of fine sediment than most of the other lower Clark Fork River tributaries, ranging from 7 to 11 percent surface fines. It had moderately high amounts of large woody debris (Washington Water and Power Company 1996). A project completed in 2001 restored about 1,000 feet of the channel in the lower East Fork Bull River with subsequent work done to reduce sediment and increase fish habitat (Avista Corp. 2007).

While each reach was not evaluated, the potential spawning and rearing areas for the stream as a whole also were estimated for the East Fork Bull River in 1992-1994 (Washington Water Power Company 1996). The percentage of potential spawning habitat in the East Fork Bull River was 0.6 percent. The percentage of potential rearing habitat in this stream was 4.1 percent. When compared to other tributaries to the lower Clark Fork River, these percentages were relatively low.

Fisher River and Miller Creek

The stream reaches surveyed in the Fisher River had gradients that were generally less than 1.0 percent. Miller Creek was sampled in 1998 and 2005, and comparisons between years are shown in Table 58. Overall, gradients were moderate to steep, and mean substrate size ranged from gravel to cobble sizes.

Table 58. Stream Geomorphology Data for West Fisher and Miller Creeks and Tributaries.

Site and Year	Rosgen Type	BFW (ft)	Pools/ ft	LWD/ft	Percent Bank Stability	Width/ Depth Ratio
1 West Fisher 1996	D4	98	1/673	1/1009	100	109
3 West Fisher 1996	B3c	18.3	1/324	1/93	24	32.9
5 West Fisher 1996	C4	19.1	1/96	1/77	89	25
8 West Fisher 1996	B3a	15.2	1/53	1/45	100	17.8
1 Miller Creek 1998	B3c	12.1		1/9.6	100	15.78
1 Miller Creek 2005	B4	16.4	dry	1/10	95	11.47
2 Miller Creek 1998	B4c	10.8	1/34	1/80	100	14.8
2 Miller Creek 2005	F4	10.9	1/54	1/18	100	29.02
3 Miller Creek 1998	F4	11.2	1/120	1/243	93	13.3
3 Miller Creek 2005	E4	13.2	1/270	1/45	86	10.19
4 Miller Creek 1998	B4c	13	1/54	1/39	97	16.6
4 Miller Creek 2005	B4c	11.3	1/139	1/132	100	12.99
5 Miller Creek 1998	B3c	9.2	1/185	1/16.2	100	16.17
5 Miller Creek 2005	B4a	9	1/47	1/37.6	100	13.64
6 Miller Creek Trib. 1998	Da4	4.3	Dry	nc	nc	21.5
6 Miller Creek Trib. 2005	Da4	3.8	Dry	1/5	100	9.87
7 Miller Creek Trib. 1998	B4	6.9	1/46	1/6	80	9.1
7 Miller Creek Trib. 2005	B4	6.1	Dry	1/8.5	100	22.59
8 Miller Creek 1998	B4c	9.8	1/66	1/28	87	13.24
8 Miller Creek 2005	F4b	11.5	1/5	1/18	100	25.68
9 South Fork Miller 1998	B4	6.7	1/33	1/8.7	80	17.96
9 South Fork Miller 2005	E4b	7	1/36	1/72	100	4.86
10 South Fork Miller 1998	C4b	5.2	1/32	1/8	32	20.08
10 South Fork Miller 2005	E4b	6	1/3.7	1/6.2	100	5.77
11 Miller Creek 1998	F4b	9.7	1/70	1/15	82	21.04
11 Miller Creek 2005	B4	8.4	1/46	1/11	100	20.48
12 North Fork Miller 1998	F3b	10	1/40	1/9	24	31.05
12 North Fork Miller 2005	F4b+	8.84	dry	1/10	50	32.81
13 Miller Creek 1998	F4b	6.8	1/64	1/128	83	28.33
13 Miller Creek 2005	F4	5.8	1/39	1/8	100	17.44
14 Miller Creek 1998	G4	4.7	1/24	1/7	100	9.79
14 Miller Creek 2005	G4	5.7	1/28	1/5	100	15.8
15 Miller Creek 1998	B4a	5.5	1/28	1/6	99.94	13.41
15 Mainstem 2005	F4B	3.0	1/10	0/60	100	16.6

Shaded values indicate RMOs or goals not met.
BFW = bank full width; LWD = large woody debris.
Source: Libby Ranger District files 2007.

3.6.3.1.2 Barriers to Fish Passage

Over the years, as part of the road system on the KNF, culverts have been installed on streams, some of which have created migration barriers to fish. Barriers have been created on tributaries to the main stems of Libby and West Fisher creeks. The KNF replaced one such barrier in 2007 on Midas Creek where the Libby Creek Road (NFS road #231) crosses the stream. Existing barriers that inhibit fish use of Libby Creek or its tributaries include: a large natural waterfall on Libby Creek; a thermal barrier in the lower several miles of the mainstem of Libby Creek near the

mouth with the Kootenai River that occurs seasonally in some years; loss of flow in various reaches (in Libby Creek near the U.S. 2 bridge and the lower segment of the stream near the mouth with the Kootenai River); and double pipe culverts on NFS road #14458 on upper Midas Creek. No permanent known man-made barriers are on the mainstem of Libby Creek. The Vaughn and Greenwall ditch, which was constructed in 1900 to provide a water source for mining activities, possibly provided a passage around the falls in Libby Creek. This ditch is no longer functional and upstream movement is no longer available. Bull trout above the falls are currently isolated from the remainder of the population although downstream movement likely occurs.

In September 2005, a search for barriers to fish passage in the analysis area was conducted (Kline Environmental Research 2005b); a survey to determine the fish passage status of culverts existing in the watershed was conducted in July and August 2005 (Kline *et al.* 2005). The only barrier on Libby Creek documented in these reports was the 39-foot waterfall (Libby Creek Falls) located about 6,200 feet upstream of the Howard Creek confluence. The portion of Libby Creek downstream of NFS road #231 and Libby Creek Falls was not searched for barriers due to FWP's restoration efforts within that reach. No culverts exist on Libby Creek within the analysis area.

Permanent barriers to fish passage were found on Ramsey Creek, Little Cherry Creek, and Poorman Creek that appear to cause portions of these tributaries to be inaccessible to fish from Libby Creek. Little Cherry Creek provides the least amount of habitat for fish from Libby Creek, as a subsurface reach exists during low flow conditions immediately at its confluence with Libby Creek. Even during higher flow conditions, about 950 feet or less of the stream is accessible to fish from Libby Creek due to a series of barriers, the most upstream of which was judged to be impassable to all fish (although small populations of redband trout have been found upstream of those barriers, as discussed below). Additionally, two culverts exist on Little Cherry Creek at the crossing of NFS roads #6212 and #278, upstream of the natural barriers. Poorman Creek has a subsurface reach near its confluence with Libby Creek, but during adequate flow conditions about 2.5 miles of lower Poorman Creek are accessible before a barrier impassable to all fish is encountered. Downstream of this barrier at the crossing of NFS road #278, a culvert that acts as a secondary barrier to juvenile trout at all flows and to adult trout at high flows also exists. Ramsey Creek is accessible to Libby Creek for about 2.7 miles before a barrier to most fish occurs, followed by a barrier to all fish about 1.5 miles upstream of that barrier. No culverts exist on Ramsey Creek (Kline Environmental Research 2005a; Kline Environmental Research *et al.* 2005).

A natural fish barrier is present immediately downstream of Rock Creek Meadows and at the outlet of Rock Lake, on Rock Creek, but these barriers do not prevent downstream fish passage. About 28 percent of Rock Creek is intermittent (GEI 2005), which may act as a barrier to migrating bull trout seasonally. A barrier is present about 1 mile upstream of the CMW boundary on the East Fork Bull River (USDA Forest Service and DEQ 2001; Washington Water Power Company 1996). The barriers were not assessed to determine if they are barriers to all fish or if they are navigable to some fish under some flow conditions.

The mainstem of West Fisher Creek has no known permanent natural or man-made barriers. A partial barrier exists at the confluence of West Fisher Creek and the Fisher River. This barrier occurs because of the high amount of bedload that is transported down West Fisher Creek. In low-water years, the stream has multiple shallow channels through which large migratory fish cannot pass. Miller Creek in the lower reaches near the confluence with the Fisher River is dry most of the year. Streamflow goes subsurface for nearly 0.5 mile in the drainage for most of the year. The

stream connects with the Fisher River only during spring high flows, or during rain or snow events.

3.6.3.2 Water Quality Characteristics

Overall surface water quality in streams and lakes within the analysis area is of excellent quality. Total suspended solids, total dissolved solids, major ions, and nutrient concentrations are very low in analysis area streams, and are frequently at or below detection limits. The low concentrations of nutrients and minerals within the analysis area severely limit the productivity potential for aquatic life. Metal concentrations are also generally low, with many metals below detection limits. Iron, copper, and silver are found in low concentrations above detection limits in most analysis area streams, perhaps reflecting the mineralized rock in the area. Rock Lake also has excellent water quality. Limited water quality data available for St. Paul Lake suggest it is somewhat less pristine than Rock Lake, but does not have constituents that inhibit aquatic life.

Because of very low alkalinities, analysis area streams are poorly buffered. Consequently, surface waters tend to be slightly acidic, with most pH values slightly below 7.0. This acidity has two likely natural sources – organic acids originating from surrounding coniferous forests and dissolved carbon dioxide (CO_2) in surface and ground water draining into the area streams. Median water hardness in all sampled streams within the Libby Creek drainage was less than 30 mg/L as calcium carbonate ($CaCO_3$), with several sampling locations with median hardness values under 10 mg/L $CaCO_3$ (Table 96 and Table 97). Water quality for the streams and lakes in the analysis area are discussed in section 3.12, *Surface Water Quality*.

3.6.3.3 Aquatic Plants and Periphyton

The results of the initial baseline monitoring conducted in 1988 and 1989 show that sparse growths of green algae (Chlorophyta), blue-green algae (Cyanophyta), and diatoms (Bacillariophyta) occur throughout the Libby Creek watershed within the analysis area. In general, the algal taxa found were typical of unpolluted, softwater streams in Montana. The low population densities are common in high-elevation streams and reflect the low nutrient content in the Libby Creek drainage waters. Of the green and blue-green algae taxa found within the analysis area, *Zygnema* and *Oscillatoria* were the most abundant and widespread genera (Western Resource Development Corp. 1989a).

Diatoms were present in all periphyton samples, but were collected at relatively low abundances at most reaches (Western Resource Development Corp. 1989a). Taxa richness also was low in these samples, ranging from 5 taxa to 27 taxa collected over the three sampling events in 1988 and 1989. The most abundant diatom taxon at most stations on most sampling dates was *Achnanthes minutissima* (Western Resource Development Corp. 1989a), which is often the first species to establish itself at a site disturbed by physical abrasion, and is common in mountain streams (Teply and Bahls 2005). When present in the samples, *A. minutissima* composed from 3 to 99 percent of the diatom community in these stream reaches. Relative abundances up to 25 percent of the diatom population indicate a normal level of disturbance, while relative abundances from 25 to 50 percent indicate minor disturbance and relative abundances greater than 50 percent indicate moderate to high levels of disturbance (Teply and Bahls 2005).

Periphyton sampling continued from 1991 through 1994. Analysis of the samples collected in 1991 and 1992 from Little Cherry Creek showed a relatively high diversity of algae taxa, possibly as a result of nutrient enrichment. Poorman and Ramsey creeks had a more limited algal diversity,

signifying low nutrient concentrations (Western Technology and Engineering, Inc. 1992, 1993). Periphyton samples were only collected from Libby Creek sites from 1993 to 1994. Based on diatom association indices (Western Technology Engineering, Inc. 1994, 1995), biological integrity upstream and at the nearest station downstream of the mining activities was good to excellent, and aquatic life was not impaired. The periphyton community did show some effects attributed to the elevated nitrogen levels in October 1991 at the site immediately downstream of the Libby Adit. Periphyton communities at this site were strongly dominated by *Ulothrix*, a green algae species that responds favorably to elevated nutrient levels. This site also had the highest diatom species richness and diversity values for that year. Biological integrity ratings were not adversely affected in latter years (Western Technology Engineering, Inc. 1994, 1995) as the periphyton community was not as strongly dominated by one green algae species in later sampling.

Periphyton samples were collected from nine sites in Rock Creek in 1985, with species composition described as typical of clean, soft waters in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). Periphyton accumulation was also monitored in Rock Creek and the East Fork Bull River in 1993 (Washington Water Power Company 1996; USDA Forest Service and DEQ 2001). When compared to other tributaries in the lower Clark Fork River, net productivity and chlorophyll content was relatively high in Rock Creek, while the chlorophyll content of the samples was relatively low in the East Fork Bull River.

Aquatic plants and mosses also were documented during the initial baseline periphyton surveys. Aquatic macrophytes occurred only incidentally within the analysis area, and included sparse numbers of water buttercup (*Ranunculus*) in spring seeps in the Libby Creek floodplain and in Rock Creek Meadows, as well as sedges (*Carex*) in Rock Creek meadows. Byrophytes (mosses) were the predominant vegetation found along many stream reaches. They were particularly abundant in the upstream portions of each stream, but were present wherever stable substrates and dense forest canopies occur. They occurred only sporadically in Libby Creek's middle reaches, if at all (Western Resource Development Corp. 1989a).

3.6.3.4 Aquatic Insects

Stream macroinvertebrates were collected from 21 locations in analysis area streams between 1986 and 2004 (Western Resource Development Corp. 1989a; USDA Forest Service and DEQ 2001; Western Technology and Engineering 1991, 1992, 1993, and 1994; Western Technology and Engineering and Phycologic 1995; Hoffman *et al.* 2002; Dunnigan *et al.* 2004; USDA Forest Service 2006). Data are summarized in Appendix F.

During the initial baseline study, mean macroinvertebrate densities and total taxa richness were highly variable (Appendix F). True flies (dipterans) were the most diverse group taxonomically, and had the highest relative abundance at some sites. Other insect groups with high diversity and relative abundances at all sites were mayflies (Ephemeroptera) and stoneflies (Plecoptera). Metal-intolerant macroinvertebrates, such as heptageniid mayflies, were consistently present at sites in each stream. Most of the macroinvertebrates collected are considered intolerant of fine sediments, heavy metals, and organic pollution (Western Resource Development Corp. 1989a).

Calculated indices characterizing macroinvertebrate communities during the initial baseline period indicated diverse macroinvertebrate communities and high water quality exist in analysis area streams. Differences in community characteristics among the stations were generally slight,

and were probably due to differences in stream order, microhabitat conditions, and variable sampling efficiencies.

Macroinvertebrate sampling continued from 1990 through 1994 at a limited number of sites. Both higher and lower values for most of the calculated metrics were observed during this period as compared to the baseline monitoring period data. No consistent spatial, temporal, or seasonal trends were apparent (Appendix F).

Macroinvertebrate data have also been collected from several reaches within analysis area streams as part of other projects. These studies included sampling reaches of East Fork Rock Creek from 1986 through 1988, and sampling reaches of Libby Creek, Bear Creek, West Fisher Creek, and the Fisher River from 1998 through 2004 (USDA Forest Service and DEQ 2001; Hoffman *et al.* 2002; Dunnigan *et al.* 2004; USDA Forest Service 2006). The data are presented in Appendix F.

More recent data for the analysis area are presented in Table 59. Taxa richness refers to the number of species collected at each site for each sampling event. Taxa richness has generally been high in recent sampling, with the exception of East Fork Rock Creek in 2005, Fisher River in 2002 and 2003, and Libby Creek Site L1 in 2002.

Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa can be used as an indicator of water quality, as they are considered sensitive to a wide range of pollutants (Plafkin *et al.* 1989; Wiederholm 1989; Klemm *et al.* 1990; Lenat and Penrose 1996; Wallace *et al.* 1996; Barbour *et al.* 1999; Lydy *et al.* 2000). The EPT index is a ratio of the number of EPT taxa collected compared to the number of total taxa collected. Values for these metrics typically increase with better water quality. The sensitive EPT taxa composed a substantial proportion of the macroinvertebrate community in all reaches sampled, making up 50 percent or more of the total number of taxa in all of the recent sampling events except for East Fork Rock Creek (Table 59). Values for the percent EPT abundance also were high during almost all sampling events, indicating that there are a diverse group of these sensitive taxa, and that they are found at high relative abundances.

Evenness ranges from 0 to 1, and is a measure of how well each species is represented within the invertebrate community. The Shannon-Weaver diversity index is recommended by the EPA as a measure of the effects of stress on invertebrate communities (Klemm *et al.* 1990). Shannon-Weaver index values greater than 2.50 are generally indicative of a healthy invertebrate community (Wilhm 1970). Most Shannon-Weaver diversity and evenness values indicated that healthy, well-balanced macroinvertebrate communities exist in the analysis area streams. Some low diversity values were recorded in East Fork Rock Creek, with values ranging from 0.69 to 1.53.

Of the metrics calculated, percent EPT is one of the most informative because it is less sensitive to differences in sampling and identification methods than most of the other metrics calculated. EPT reflects proportional abundances rather than actual numbers of invertebrates collected. A high abundance of EPT organisms indicates good water quality, as these taxa are generally intolerant of pollutants, low oxygen, high sediment loads, and high temperatures. Percent EPTs were generally high at most sites during most sampling events, and few trends between sites, years or seasons were identified.

Table 59. Characteristics of Macroinvertebrate Populations during 2000-2005.

Stream	Sampling Site	Sampling Date	Taxa Richness	EPT Taxa Richness	EPT Index	Shannon-Weaver Diversity Index	Evenness	Data Source
Libby Creek Reach Immediately Upstream of Falls	L9	Sep-00	24	16	67	2.26	0.5633	USFS 2006
	L9	Aug-01	39	28	72	2.55	0.4860	
	L9	Aug-03	41	28	68	2.47	0.5340	
	L9	Jul-04	30	24	80	2.47	0.5910	
Libby Creek Reach Near Midas Creek Confluence	L4	Sep-00	33	25	76	NC	NC	Dunnigan *et al.* 2004; Hoffman *et al.* 2002
	L4	Aug-03	35	28	80	NC	NC	
Libby Creek Reach Near Bear Creek confluence	L3	Jul-04	21	18	86	2.63	0.7720	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	L1	Oct-00	29	22	76	2.25	0.5537	USFS 2006
	L1	Aug-01	43	28	65	2.59	0.5370	
	L1	Aug-02	13	11	85	2.25	0.8820	
	L1	Aug-03	34	24	71	3.09	0.7850	
	L1	Jul-04	42	27	64	1.75	0.2790	
Bear Creek	Be3	Aug-00	32	24	75	2.75	0.6500	USFS 2006
	Be3	Aug-01	33	23	70	2.66	0.5710	
	Be3	Aug-03	39	29	74	3.01	0.7150	
	Be3	Jul-04	28	22	79	2.54	0.6440	
East Fork Rock Creek	SB-1	Sep-05	9	4	44	1.53	0.4819	Geomatrix 2006
	SB-2	Sep-05	7	2	29	1.08	0.3831	
	SB-3	Sep-05	11	4	36	0.69	0.1986	
Fisher River at U.S. 2		Aug-01	34	19	56	2.62	0.5910	USFS 2006
		Jul-02	10	7	70	2.02	-	
		Aug-03	16	9	56	2.10	0.5920	
		Jul-04	37	25	68	1.92	0.4530	
West Fisher Creek		Oct-00	28	17	61	2.26	0.5547	USFS 2006
		Aug-01	39	26	67	2.83	0.5960	
		Jul-02	29	19	66	2.64	0.6210	
		Aug-03	39	23	59	2.79	0.6540	
		Jul-04	27	20	74	2.51	0.5970	

EPT = Ephemeroptera, Plecoptera, and Trichoptera.

These general findings indicate that the macroinvertebrate communities within the analysis area are variable temporally, spatially, and seasonally, and are likely influenced by factors other than water quality. The flow regime may be a major factor affecting macroinvertebrate abundances, with repeated high flow events resetting densities at low levels. The natural flow regime is dictated by drainage basin characteristics and precipitation events.

3.6.3.5 Fisheries

3.6.3.5.1 Libby Creek Drainage Fish Populations

1988 Survey Results

Electrofishing studies were conducted for the initial baseline study at 12 sites located on Libby Creek, Poorman Creek, Ramsey Creek, Little Cherry Creek, and East Fork Rock Creek in August and September 1988 (Figure 53 and Table 60). Native salmonid fish species collected within the Libby Creek drainage were redband trout and bull trout. While no effort was made to collect sculpins (*Cottus* sp.), they were noted as common at some sites. Both torrent sculpin and slimy sculpin inhabit the Libby Creek drainage. Torrent sculpin is a Montana Species of Concern. Redband trout was the dominant trout species in all analysis area streams in the Libby Creek watershed, ranging from 65 percent of the trout collected in Ramsey Creek, to 100 percent of the trout collected in Little Cherry Creek. Bull trout were collected from all analysis area streams except for Little Cherry Creek. Trout densities in all streams within the Libby Creek drainage were low (Table 60), with all streams except for Little Cherry Creek having no more than 8 trout per 100 square meters.

No trout were collected at the most upstream sites on Libby Creek (L11) or Ramsey Creek (Ra4). Site Ra4 was located above a barrier to all fish. Site L11 also may be located upstream of a barrier to fish passage, but barrier surveys did not extend that far upstream (Kline Environmental Research 2005b). Site L11 is the only site within the CMW in the Libby Creek drainage.

Using external characteristics to differentiate between pure interior redband trout and redband/rainbow, redband/cutthroat trout, and rainbow/cutthroat trout hybrids in the field is not reliable. Because no genetic analyses were performed at the time of this study, some uncertainty exists as to whether the redband trout collected during this study were pure redband trout or hybrids. Based on the results of genetic analyses conducted after the initial baseline study and described below, hybridization of redband trout with stocked rainbow trout and westslope cutthroat trout does occur in the analysis area streams.

Trout scales were analyzed for age and growth during the 1988 baseline survey. Most trout within the analysis area were young (age I, II, and III), as is typical for low productivity mountain headwater streams. Older (age IV) redband trout were found only in Ramsey Creek, while older bull trout (age IV or V) were found at sites on Ramsey and Libby creeks. Growth rates for all age classes were low, likely due to limitations caused by the low nutrient concentrations.

Table 60. Redband, Bull, and Westslope Cutthroat Trout Population Characteristics in 1988 in Analysis Area Streams.

Site/ Stream	Redband Trout			Bull Trout			Westslope Cutthroat Trout		
	Density (fish/100 m^2)	Average Length (cm)	Average Weight (grams)	Density (fish/100 m^2)	Average Length (cm)	Average Weight (grams)	Density (fish/100 m^2)	Average Length (cm)	Average Weight (grams)
Libby Creek									
L2	3	12.4	22.7	<1	12.2	9.1	0	—	—
L8b	0	—	—	2	18.0	59.0	0	—	—
L10	0	—	—	2	19.3	68.0	0	—	—
L11	0	—	—	0	—	—	0	—	—
Little Cherry Creek									
LC1	18	9.1	9.1	0	—	—	0	—	—
LC2	16	9.7	13.6	0	—	—	0	—	—
Poorman Creek									
Po0	8	11.9	22.7	<1	16.8	49.9	0	—	—
Po1a	8	11.7	22.7	0	—	—	0	—	—
Ramsey Creek									
Ra2a	3	12.4	27.2	2	13.7	40.8	0	—	—
Ra3	2	15.7	45.4	1	20.1	77.1	0	—	—
Ra4	0	—	—	0	—	—	0	—	—
Rock Creek									
East Fork Rock Creek	0	—	—	4	16.0	40.8	10	14.2	36.3
Rock Creek Meadows	0	—	—	0	—	—	ND[†]	22.4	122.5
Rock Lake	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = Not determined. Methods used in Rock Creek Meadows did not allow for density determinations.
[†]Westslope cutthroat trout collected at Rock Creek Meadows site are thought to be hybridized with Yellowstone cutthroat trout and rainbow trout.
Source: Western Resource Development Corp. 1989a.

Libby Creek Fish Populations and Genetics

Data from the MFISH database (FWP 2008a) and other sources were combined with data from the initial baseline survey to compose a list of all fish species that occur for each stream. Based on these data, the following fish species occur in the segment of Libby Creek within the analysis area: rainbow trout, interior redband trout, westslope cutthroat trout, bull trout, brook trout (*Salvelinus fontinalis*), slimy sculpin (*Cottus cognatus*), mountain whitefish (*Prosopium williamsoni*), longnose dace (*Rhinichthys cataractae*), largescale suckers (*Catostomus macrocheilus*), and various salmonid hybrids noted above. Results of the specific surveys documented in the either MFISH database (FWP 2008a), Kline Environmental Research (2004), or Dunnigan *et al.* (2004, 2005) only record rainbow trout (presumably referring to redband trout, rainbow trout, and their hybrids), brook trout, bull trout, and sculpin as having been collected from the segment of Libby Creek downstream of Libby Creek Falls, and only bull trout as having been collected from the segment of Libby Creek upstream of the falls.

Surveys conducted from 1988 through 2004 show variable trout densities between years and survey sites, ranging from no trout collected during surveys of some reaches to up to 12 to 117 trout/100 meters (m) within a reach (Kline Environmental Research 2004; Dunnigan *et al.* 2005). Redband trout and/or their hybrids were the dominant trout species at almost all sites downstream of the falls during years sampled. Bull trout were generally collected in low numbers in most reaches downstream of the falls. These data are consistent with the results of the initial baseline surveys. Brook trout were first collected in Libby Creek within the analysis area in 2004, but were collected more frequently from Libby Creek sites downstream of the analysis area in earlier years (Kline Environmental Research 2004; Dunnigan *et al.* 2005).

Genetic analyses were performed on rainbow trout tissues collected from sites in Libby Creek within the analysis area in 1991, 1992, 2000, and 2006. The analyses conducted in 1991 and 2000 from Libby Creek between the confluence of Howard Creek and Ramsey Creek (FWP 2008a) showed that all fish collected were rainbow trout. Clarification as to the sub-species of rainbow trout was not found for the 1991 analysis in the MFISH database. A memo from Robb Leary (2003) of the University of Montana to Mike Hensler of the FWP stated that the 2000 analyses were characteristic of a pure redband trout population. These results suggest that the 1991 analysis results likely also referred to redband trout. Non-native rainbow trout have been stocked in Howard Lake, potentially allowing these trout to access Libby Creek through Howard Creek.

Trout also were collected for genetic analysis in 1992 from a more downstream segment of Libby Creek between the confluences of Ramsey and Poorman creeks. These trout were shown to be redband trout/rainbow trout hybrids (52.3 percent redband, 45.7 percent rainbow). The trout collected for the 2006 genetic analyses were from a reach of Libby Creek upstream of the Little Cherry Creek confluence. Results indicated that these trout were rainbow trout/westslope cutthroat trout hybrids (98.9 percent rainbow, 1.1 percent westslope cutthroat trout), instead of the redband trout/rainbow trout hybrids that were collected farther upstream in 1992. The subspecies of rainbow trout was not specified in the 2006 analyses (FWP 2008a).

Little Cherry Creek Fish Populations and Genetics

The Libby Creek tributaries have a lower diversity of fish species than the Libby Creek mainstem, with redband trout dominating other trout species in these streams. The MFISH database (2008a) lists interior redband trout, rainbow trout, bull trout, westslope cutthroat trout/rainbow trout hybrids, and redband/rainbow trout hybrids as occurring in Little Cherry

Creek. Field data for all surveys summarized in the MFISH database and by Kline Environmental Research (2004) document only the collection of "rainbow" trout, with no specific data pertaining to the collection of bull trout or any other species. Only one additional survey is documented in MFISH other than the results of the initial baseline study. This survey was conducted from a section of Little Cherry Creek about 1 mile upstream from its confluence with Libby Creek and documents 24 rainbow trout (presumably redbands or their hybrids) collected from an unknown length of the stream.

Genetic analyses were performed on trout collected in 1991, 1992, and 2005 from Little Cherry Creek. The earlier results of the genetic analysis conducted on the 25 trout collected in 1991 and the five trout collected in 1992 determined that these trout were redband/westslope cutthroat trout hybrids (1991 analysis) and redband/rainbow trout hybrids (1992 analysis) (Kline Environmental Research 2004; FWP 2008a). A recent genetic analysis conducted on 30 trout collected in 2005 from Little Cherry Creek determined that the trout population was composed of non-hybridized pure redband trout (Leary 2006). The 2005 results prompted the re-examination of the 1991 and 1992 results. Re-analysis of the 1991 results determined that what was initially taken to be a small amount of hybridization with westslope cutthroat trout was more likely to be redband trout genetic variation that was indistinguishable from that usually characteristic of westslope cutthroat trout due to the small sample size. The 1992 results also were determined to have erroneously reported that the trout population was hybridized with rainbow trout due to the limited genetic sampling that had occurred throughout the drainage. More recent genetic sampling in the area resulted in those analyses being re-interpreted so as to confirm the presence of a non-hybridized redband trout population in Little Cherry Creek (Leary 2006).

Poorman Creek Fish Populations and Genetics

Poorman Creek has been sampled four times between 1982 and 1994, with total trout densities at sites ranging from 5 trout/100 m to 36 trout/100 m (Kline Environmental Research 2004; FWP 2008a). Rainbow trout (no sub-species listed) and slimy sculpin are listed as occurring commonly in the creek, with bull trout occurring rarely (FWP 2008a). Genetic analyses were conducted on tissues from five trout in 1991 and 25 trout in 2000, and indicated that the trout population in Poorman Creek consists of pure rainbow trout, but does not specify the subspecies of rainbow trout (FWP 2008a). The memo from Robb Leary (2003) to Mike Hensler states that the allele frequencies detected during the genetic analyses are actually characteristic of redband trout, not rainbows. The memo also states that while the population should conservatively be considered non-hybridized, the possibility of the population being slightly hybridized with westslope cutthroat trout cannot be ruled out without further data.

Ramsey Creek Fish Populations and Genetics

Fish distribution surveys on Ramsey Creek were conducted during three years between 1976 and 1988, with bull trout and redband trout collected at total densities ranging from 4 to 26 trout/100 m (Kline Environmental Research 2004; FWP 2008a). Genetic analysis performed on six trout collected from Ramsey Creek in 1991 (FWP 2008a) indicated that the rainbow trout population was hybridized with westslope cutthroat trout (98.7 percent rainbow trout, 1.3 percent westslope cutthroat trout). Although the MFISH database does not specify the sub-species of rainbow trout indicated to have hybridized with westslope cutthroat trout, based on the historical distribution of redband trout throughout this area and the results of subsequent genetic analyses, these hybrids are likely redband trout hybridized with westslope cutthroat trout rather than rainbow trout hybrids. An additional 25 fish were analyzed in 2000. Analysis revealed that 24 of those trout

were pure redband trout, and one trout was a redband/westslope cutthroat hybrid. Based on the results of this analysis, the memo from Robb Leary to Mike Hensler (2003) stated that the population could be considered to be redband trout from a management perspective.

Bear Creek Fish Populations and Genetics

Bear Creek is north of the Little Cherry Creek Tailings Impoundment Site, and was not surveyed in 1988 as part of the initial baseline study. It was surveyed frequently after 1988. Based on the MFISH database, brook trout, bull trout, redband trout, rainbow trout, and westslope cutthroat trout have been observed in Bear Creek. During most sampling events in Bear Creek that occurred from 1982 through 1995, rainbow (presumably redband and redband hybrid) trout have been the dominant species, ranging from 38 to 100 percent of the trout observed. Westslope cutthroat trout (or their hybrids) were observed in the 1994 and 1995 sampling events, and a single brook trout was observed in 1994. Bull trout have been observed during almost every sampling event, both in the upstream and downstream portions of the creek, and have ranged from 3 to 62 percent of all fish collected. Since 1994, no more than 18 percent of the fish collected have been identified as bull trout. Additionally, while the number observed was not provided, bull trout continued to be documented as present in Bear Creek in recent sampling events from 1999 to 2004 (FWP 2008a).

Genetic testing has been conducted twice on trout tissues collected from Bear Creek. The results of the analysis of four trout in 1991 indicated that the trout population consisted of rainbow/cutthroat hybrids (98.7 percent rainbow, 1.3 percent cutthroat), but did not indicate whether “rainbow” referred to rainbow or redband trout genes. Based on the analyses conducted in 2000, the trout population in Bear Creek is composed of redband/westslope cutthroat hybrids, as 29 of the trout analyzed were redbands, with the remaining fish being a redband/cutthroat hybrid (FWP 2008a).

2005 Survey Results

To assess where fish populations and species composition have remained relatively unchanged since the initial baseline study was conducted, day and night snorkeling surveys were conducted at 10 sites located on Little Cherry Creek, Libby Creek, Poorman Creek, and Ramsey Creek in July and August 2005. Overall, the distribution of fish within the analysis area was similar to those reported in previous surveys (Table 61). As already discussed, redband trout, rainbow trout, and their hybrids (redband/rainbow and redband/cutthroat hybrids) cannot always be visually distinguished based on external characteristics and were recorded only as *Oncorhynchus* sp. during these surveys. While the brook trout and bull trout surveyed had external characteristics consistent with one or the other species, hybrids between these two species also occur and could affect the results. Additionally, both torrent and slimy sculpin are found in analysis area streams and cannot be readily identified based on external morphology. Sculpin were not identified at the species level. Consistent with the 1988 results, the dominant fish species at all sites where fish were observed was *Oncorhynchus* sp. (Kline Environmental Research and Watershed Consulting 2005a).

Table 61. Total Fish Counts per 1,000-foot Stream Reach During Day and Night Snorkeling Surveys.

Site	Time	Fish Species						Young of Year Fish
		Oncorhynchus sp.	Brook Trout	Bull Trout	Sculpin	Longnose Dace	Largescale Sucker	
Libby Creek								
L1	Day	53	12	0	0	0	0	49
	Night	102	8	1	10	35	5	4
L2	Day	53	0	1	1	0	0	14
	Night	96	0	0	1	0	0	13
L3	Day	114	7	0	1	0	0	18
	Night	94	4	2	0	0	0	1
Little Cherry Creek								
LC1	Day	11	0	0	0	0	0	15
	Night	11	0	0	0	0	0	17
LC2	Day	5	0	0	0	0	0	1
	Night	35	0	0	0	0	0	0
LC3	Day	0	0	0	0	0	0	0
	Night	0	0	0	0	0	0	0
Poorman Creek								
Po1	Day	62	0	0	1	0	0	11
	Night	72	0	0	2	0	0	1
Po2	Day	0	0	0	0	0	0	0
	Night	0	0	0	0	0	0	0
Ramsey Creek								
Ra2	Day	28	0	1	0	0	0	1
	Night	24	0	2	0	0	0	0
Ra3	Day	27	0	0	0	0	0	0
	Night	35	0	0	0	0	0	0
Ra4	Day	0	0	0	0	0	0	0
	Night	0	0	0	0	0	0	0

Source: Kline Environmental Research and Watershed Consulting 2005a.

Abundance and number of fish species were greatest in Libby Creek during the 2005 surveys (Table 61). Brook trout, a non-native species, were first collected in Libby Creek within the analysis area in 2004 (Kline Environmental Research 2004). During the 2005 survey, brook trout outnumbered bull trout by a nearly 8 to 1 ratio at the Libby Creek sites. Longnose dace and large-scale suckers were only seen at the most downstream Libby Creek site during the nighttime snorkeling surveys. Sculpin were most abundant at this site, and also were seen in higher numbers during the night surveys (Kline Environmental Research and Watershed Consulting 2005a).

The only fish observed in Little Cherry Creek in the 2005 study were *Oncorhynchus* sp. (Table 61), consistent with the initial baseline survey. *Oncorhynchus* sp. was also the only trout species observed in Poorman Creek in the 2005 study, although bull trout were documented in the 1988 surveys, as well as surveys conducted afterward. No fish were seen upstream of the first

permanent fish barrier in Poorman Creek (Kline Environmental Research and Watershed Consulting 2005a; Kline Environmental Research 2005b). Both bull trout and *Oncorhynchus* sp. were observed in Ramsey Creek. Bull trout were not seen at the upper Ramsey Creek site as was reported in the initial baseline survey. As with Poorman Creek, no fish were observed in Ramsey Creek upstream of the first permanent barrier to all fish (Kline Environmental Research and Watershed Consulting 2005a; Kline Environmental Research 2005b).

3.6.3.5.2 Lower Clark Fork River Drainage Fish Populations

Rock Creek Fish Populations and Genetics

During the initial baseline surveys in 1988, westslope cutthroat trout were the dominant trout species in East Fork Rock Creek, comprising 71 percent of all trout collected and having a density of 10 trout/100 m^2 (Table 60). Many of the westslope cutthroat trout collected from the Rock Creek Meadows site near the outlet of Rock Lake were thought to be hybridized with Yellowstone cutthroat trout and rainbow trout. Bull trout also were collected during these surveys at densities of 4 trout/100 m^2. The trout scales analyzed for age and growth during the 1988 baseline survey indicated that most trout within the analysis area were young (age I, II, and III), as is typical for low productivity mountain headwater streams as older fish reside in larger downstream areas. Older bull trout and westslope cutthroat trout (age IV and/or V) also were found in East Fork Rock Creek and Rock Creek Meadows, respectively. As in the Libby Creek drainage streams, growth rates for all age classes were low, likely due to limitations caused by the low nutrient concentrations and harsh environmental conditions.

In addition to the bull trout and westslope cutthroat trout observed in East Fork Rock Creek during the initial baseline survey, brook trout, brown trout (*Salmo trutta*), Yellowstone cutthroat trout, rainbow trout, and westslope/Yellowstone/rainbow trout hybrids also occur in Rock Creek and East Fork Rock Creek. Fish populations from one or more sites in East Fork Rock Creek and Rock Creek were surveyed in 1985, 1986, 1988, 1993, 1996, and 2000-2007 (USDA Forest Service and DEQ 2001; FWP 2008a). While only presence-absence data or counts were recorded for many of these earlier surveys, most surveys since 2000 measured trout densities using depletion estimates over about 100 meters of stream (Horn and Tholl 2008). Total trout densities recorded from surveys in East Fork Rock Creek as summarized by the USDA Forest Service and Montana Department of Environmental Quality (2001) ranged from 13 to 36 trout/100 m^2, with westslope cutthroat trout comprising from 69 to 93 percent of the total trout collected during the 1985 to 2000 period. Bull trout were the only other trout species collected in these surveys, and they were collected at densities up to 11 trout/100 m^2 during this time period. More recent data indicate a gradual increasing trend in bull trout from 2001 to 2007 with bull trout increasing from 7 to 26/100 m over that time period (Horn and Tholl 2008). Westslope cutthroat trout have ranged from 51 to 109/100 m over this latter time period.

In the mainstem of Rock Creek, total trout densities were generally lower than in the East Fork Rock Creek, but reached up to 32 trout/100 m^2, with westslope cutthroat trout also dominating the fish populations in most surveys (as summarized in USDA Forest Service and DEQ 2001). Brook trout were the dominant species in downstream reaches during two surveys in 1993 and 1996. Based on these surveys and the surveys documented in the MFISH database (2008a), brook trout appear to only inhabit the downstream reaches of Rock Creek. Bull trout were collected in low densities in some surveys in the mainstem Rock Creek, but generally were collected less frequently and in lower densities than in East Fork Rock Creek (USDA Forest Service and DEQ 2001).

The initial baseline study discusses results of genetic analyses from fish collected in 1984 (Western Resource Development Corp. 1989a; FWP 2008a) from near the mouth of Rock Creek and near the Rock Creek Meadows site. Based on the results of these analyses, the westslope cutthroat population at the mouth of Rock Creek was considered pure, but subject to genetic invasion, while the Rock Creek Meadows population was considered to be hybridized (92.8 percent westslope cutthroat trout, 5.2 percent Yellowstone cutthroat trout, and 2 percent rainbow trout) (Western Resource Development Corp. 1989a). Past stocking activities in Rock Lake or Rock Creek Meadows are responsible for this hybridization. East Fork Rock Creek has barriers to upstream fish movement in Rock Creek Meadows and at the outlet of Rock Lake, but these barriers do not prevent downstream fish passage. Hybridized cutthroat trout have access into areas occupied by pure strains (USDA Forest Service and DEQ 2001; Washington Water Power Company 1996).

As part of Avista's monitoring of bull trout in Rock Creek and Bull River, 10 radio tagged bull trout were detected between 2003 and 2007 moving into Rock Creek, including one fish that was detected in the drainage 2 years in a row. Observations of these radio tagged fish along with capture of migratory sized adult bull trout in weir traps installed in Rock Creek indicate low, but stable red count numbers over the years. In 2007, an adult bull trout captured below Cabinet Gorge Dam had previously been captured as a juvenile in Rock Creek in 2005 was transported and released in Rock Creek. Additional information about Avista's monitoring is reported in Lockard *et al.* 2003, 2004a; Lockard *et al.* 2004b; Lockard and Hintz 2005; Lockard *et al.* 2005; Hintz and Lockard 2006, 2007; Lockard *et al.* 2008; Bernall and Lockard 2008.

East Fork Bull River Fish Populations and Genetics

The East Fork Bull River was not surveyed as part of the initial baseline study, but was surveyed between 1992 and 1994, 1999, and 2000-2007 (Washington Water Power Company 1996; Chadwick Ecological Consultants, Inc. 2000; Horn and Tholl 2008; FWP 2008a). Results from these surveys indicate that brook trout, brown trout, bull trout, westslope cutthroat trout, mountain whitefish, sculpin, and northern pikeminnow (*Ptychocheilus oregonensis*) are present in the East Fork Bull River. While no density estimates were available from the MFISH database, fish densities were reportedly high for cutthroat trout and brown trout during the 1992-1994 surveys, and lower for bull and brook trout (Washington Water Power Company 1996). Fish densities were estimated from snorkeling surveys within four reaches of the East Fork Bull River in 1999 (Chadwick Ecological Consultants, Inc. 2000). Westslope cutthroat trout and bull trout were found in all four reaches of the East Fork Bull River. In all reaches, westslope cutthroat trout were the dominant species, with densities up to 2 trout/100 m^2. Based on these estimates, the East Fork Bull River had about 2,600 westslope cutthroat trout present throughout its length.

Bull trout were collected at considerably lower densities than westslope cutthroat trout in the East Fork Bull River in 1999, with all reaches having less than 1 trout/100 m^2 (Chadwick Ecological Consultants, Inc. 2000). Generally, bull trout densities were highest in the upstream reaches of this stream. The East Fork Bull River was estimated to have about 200 bull trout present throughout its length. Subsequent sampling in the East Fork Bull River since 2000 has shown estimates of up to 7.3 trout/100 m in 2003 in downstream areas to as high as 43 bull trout/100 m in more upstream reaches in 2005 (Horn and Tholl 2008). Surveys of reaches in other streams within the Bull River drainage in 1999 indicated that the majority of the bull trout in this watershed are found in the East Fork, with 85 percent of the all the bull trout collected in the Bull River watershed collected from the East Fork Bull River. Of the other fish species collected in the

East Fork Bull River, brown trout, brook trout, and mountain whitefish were observed in one or both of the two downstream reaches, while sculpin were observed in all but the most upstream reach (Chadwick Ecological Consultants, Inc. 2000). Results from sampling from 2000 through 2007 by Avista show similar patterns (Horn and Tholl 2008).

The additional surveys recorded in the MFISH database (2008a) only gave the number of fish collected, but these numbers indicated that trout density is relatively high in the East Fork Bull River, particularly near the confluence with the Bull River. Brown trout was the dominant fish species in most of these surveys, but westslope cutthroat, brook trout, and mountain whitefish were collected in high numbers during many of the surveys. Sampling by Avista found similar results, with brown trout generally being the most abundant species in the lower reaches, but bull trout, brook trout, mountain whitefish, and westslope cutthroat trout also being present (Horn and Tholl 2008). Northern pike minnows and sculpins were collected more rarely and generally in low numbers (Chadwick Ecological Consultants, Inc. 2000; FWP 2008a). Fish found in the upper reaches within the CMW included bull trout, westslope cutthroat trout, and slimy sculpin (FWP 2008a).

Length-frequency data and scale analysis conducted during the 1999 survey suggest that the migratory life form of bull trout exists in the Bull River drainage. Resident bull trout also may exist in the drainage, as some younger trout within the size range expected for resident trout were observed. The absence of “resident” fish past age III raises uncertainties about the existence of a true resident population (Chadwick Ecological Consultants, Inc. 2000). Research has shown radio tagged bull trout transported from Lake Pend Orielle moving to the East Fork Bull River. The genetic information, sampling surveys, and telemetry indicated that this population is primarily a migratory population (Katzman and Hintz 2003).

Genetic analysis of bull trout tissues collected in 1993 from three locations on the East Fork Bull River indicated that the bull trout populations were pure. Genetic analyses conducted on westslope cutthroat trout tissues in 1983, 1984, and 2004 also determined that these populations were pure (FWP 2008a).

3.6.3.5.3 Fisher River Drainage Fish Populations and Genetics

All of the alternative transmission line alignments would follow or cross streams within the Fisher River watershed. Brook trout, bull trout, rainbow trout, mountain whitefish, largescale suckers, longnose dace, longnose suckers (*Catostomus catostomus*), redside shiners (*Richardsonius balteatus*), and sculpin are listed as residing in the reach of the Fisher River (FWP 2008a). Genetic surveys conducted on 90 rainbow trout collected from three locations in the upstream portion of the Fisher River in 2005 indicate these are pure interior redband trout.

Additionally, one or more of the transmission line alternatives follows and/or crosses West Fisher Creek and Miller Creek, all of which are tributaries to the Fisher River. The MFISH database lists brook trout, bull trout, redband trout, mountain whitefish, rainbow trout, sculpin, and westslope cutthroat trout as occurring in West Fisher Creek. Surveys of this stream were conducted in 1987, 1993, and 2002-2004, and documented the collection of rainbow trout, brook trout, bull trout, and mountain whitefish. Surveys conducted near the confluence of West Fisher Creek and the Fisher River indicate that rainbow trout were the dominant species. Only bull trout were collected from the surveys conducted about 3.7 miles upstream of the confluence. Tissues from 25 trout collected in 2000 from West Fisher Creek underwent genetic analysis and were determined to be westslope/rainbow trout hybrids. Miller Creek, a tributary to the Fisher River is reported to

contain brook trout, redband trout, pure westslope cutthroat trout, redband/cutthroat hybrids, slimy sculpin, and torrent sculpin, with genetic analysis indicating that the westslope cutthroat trout were 100 percent pure (FWP 2008a).

3.6.3.5.4 Analysis Area Lakes

Rock Lake, St. Paul Lake, Howard Lake, Ramsey Lake, Upper Libby Lake, and Lower Libby Lake are within the analysis area. While no fish population data were available for Ramsey Lake, St. Paul Lake or the Libby Lakes, the MFISH database (2008a) indicates that Yellowstone cutthroat/westslope cutthroat trout hybrids inhabit Rock Lake. Nineteen fish were collected in Rock Lake in 1988, with some thought to be pure westslope cutthroat trout and other hybrids (Western Resource Development 1989). Genetic analyses were conducted on trout from this lake in 1985 and 1993. Results of both analyses were similar, and indicated that the fish are hybridized in Rock Lake, containing between 79 percent and 82 percent westslope cutthroat trout genes, and between 18 percent and 21 percent Yellowstone cutthroat trout genes. Based on the MFISH database, stocking of rainbow trout in Rock Lake occurs annually. In Howard Lake, non-native rainbow trout are considered abundant and are stocked annually by FWP (FWP 2008a).

3.6.3.6 Spawning Surveys

In October 1989, about 22 miles of Libby, Ramsey, and Poorman creeks were surveyed for bull trout redds (spawning nest made by trout) as part of the initial baseline study. Two spawning areas made by large, apparently migratory bull trout were found downstream of the project. Above the falls, 10 small bull trout redds also were found, which were the product of resident fish. No bull trout spawning activity was observed in Ramsey Creek or Poorman Creek. Also, no spawning or spent bull trout or mountain whitefish were observed in the 11-mile portion of Libby Creek surveyed during the November 1988 mountain whitefish survey (Western Resource Development Corp. 1989a; Kline Environmental Research 2004). Additionally, 18 redds were observed in West Fisher Creek in 1999, and 23 redds were observed in 2000.

Redd surveys also were conducted in October 1995 and 1996 in Libby, Ramsey, Poorman, and Little Cherry creeks. Four possible redds were noted, one on Libby Creek upstream of its confluence with Little Cherry Creek, and three on Ramsey Creek. The three redds identified on Ramsey Creek were noted as possibly being brook trout redds (Kline Environmental Research 2004), but are more likely to have been bull trout redds because surveys have not reported brook trout as occurring in Ramsey Creek. As part of the mitigation efforts for the construction and operation of Libby Dam, redd surveys were conducted on Bear Creek annually from 1995 through 2004. About 4 miles were surveyed on each occasion, with the number of bull trout redds observed ranging from four in 2001 to 36 in 1999 (Dunnigan *et al.* 2004, 2005).

Redd surveys also have been conducted by the FWP and KNF within the Fisher River, East Fork Bull River, and Rock Creek watersheds. The Fisher River watershed was surveyed for redds in 1993, with one suspected bull trout redd observed in the Fisher River itself, and 12 redds observed within other tributaries in the drainage (Kootenai Tribe of Idaho and FWP 2004).

The East Fork Bull River has been surveyed for both brown and bull trout redds (Washington Water Power Company 1996; Avista Corp. 2007). Brown trout redds were surveyed from 1980 through 1982, with an average of 33 redds observed each year. Surveys for bull trout redds were begun in 1992, with 12 redds observed. Both bull trout and brown trout redd surveys were conducted in 1993, 1994, and 1995. Three brown trout redds were observed in 1993, but no bull

trout redds were found. Accurate redd counts were not possible in 1994 and 1995 due to high flows (Washington Water Power Company 1996). Bull and brown trout redd surveys also were conducted on the East Fork Bull River and Rock Creek from 2001 to 2007 by Avista (Storaasli and Moran 2008). The number of bull trout redds in the East Fork Bull River ranged from nine in 2004, 2005, and 2007 to a high of 32 in 2002. Brown trout redd surveys during this same time period for East Fork Bull River ranged from five in 2006 to 46 in 2002 (Storaasli and Moran 2008).

Washington Water Power Company (1996) also conducted redd surveys on Rock Creek in 1993-1995. As in the East Fork Bull River, the redd surveys in 1994 and 1995 did not result in accurate counts due to high flow conditions. Only a single bull trout redd was found in Rock Creek during the 1993 survey. In the Avista surveys, bull trout redds in Rock Creek ranged from zero in 2001 to six in 2004 (Storaasli and Moran 2008).

3.6.3.7 Heavy Metal Concentrations in Fish Tissues

Concentrations of copper, lead, mercury, zinc, and cobalt in redband trout tissues collected in 1988 are shown in Table 62. Mercury concentrations were measured in muscle tissue, while all other metal concentrations (*e.g.*, copper, lead, and zinc) were measured in liver tissue (Western Resource Development Corp. 1989). The current water quality criteria level for mercury in fish tissues for the protection of human health is 0.3 mg/kg whole body wet weight (Environmental Protection Agency 2001). The initial baseline study report (Western Resource Development Corp. 1989a) does not specifically state if the results listed in Table 62 were based on wet weight or dry weight, although it does mention that "it was difficult to weigh the frozen samples due to loss of moisture." Based on this, the best assumption is that the samples were intended to be weighed as wet weight. All mean concentrations of mercury in the sampled fish were below the level set by the EPA. Regulatory criteria for metal concentrations in fish tissues have not been established for the remaining metals. The trout used for the metals analyses were collected from a reach on Libby Creek located below all potential tailings and facility sites, in order to provide baseline data for metal levels regardless of the locations of these structures.

Table 62. Metals Concentrations in Redband Trout in Libby Creek.

Metal	Minimum Metal Concentration (µg/g)	Maximum Metal Concentration (µg/g)	Average Metal Concentration (µg/g)
Cobalt	0.1	12.4	1.9
Copper	2.4	29.4	6.5
Lead	<0.1	<1.4	<0.5
Mercury	0.1	0.4	0.19
Zinc	22.3	62.8	30.1

µg/g = microgram per gram.
Note: Mercury concentrations were measured in muscle tissue, while all other metal concentrations were measured in liver tissue. Results given were not specified as wet weight or dry weight measurements, but are presumed to be based on wet weight.
Source: Western Resource Development Corp. 1989a.

Metals concentrations also were analyzed in westslope cutthroat trout tissues collected from Rock Creek and East Fork Rock Creek in 1985, as reported in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). In East Fork Rock Creek, mean copper concentrations were 3.0

microgram per gram (µg/g), mean zinc concentrations were 75.0 µg/g, and mean mercury concentrations were 0.1 µg/g. In the mainstem Rock Creek, mean copper concentrations were 3.0 µg/g, mean zinc concentrations were 82.0 µg/g, and mean mercury concentrations were 0.1 µg/g. Mercury concentrations were measured in muscle tissue similar to the tissue from fish collected in the Libby Creek drainage. Copper and zinc concentrations were measured in gill tissue. These concentrations are assumed also to be based on wet weights. Copper and mercury concentrations in samples from Rock Creek and East Fork Rock Creek fish were generally less than concentrations in samples from Libby Creek fish, while zinc concentrations were substantially higher.

3.6.3.8 Historical Impacts on Fisheries

Baseline aquatic data reflect the influences of historical mining activities on fishery and habitat conditions in Libby Creek. Prior to the 1860s, the upper valley was essentially intact, influenced primarily by wildfires and floods. While Native Americans used the upper valley for subsistence purposes (harvesting berries and wildlife), upper Libby Creek was not among those streams routinely used for fishing (USDA Forest Service *et al.* 1992).

In 1867, placer mining began in Libby Creek and its tributaries, including the analysis area (Kline Environmental Research 2004). By 1868, about 800 miners were working the bed of Libby Creek and its tributaries, diverting streams, and cutting timber for housing and placer works. Left behind were scattered patches of disturbed streambed, floodplains devoid of timber, and degraded aquatic habitat.

In 1887, the mining community of Old Libby was established in the area. From the mid-1890s to 1937, hydraulic mining extended impacts on fisheries in the upper valley of Libby Creek within the analysis area (Kline Environmental Research 2004). After excavating and washing old stream channels, floodplains, and streambanks for gold and silver, the “waste” was left in place or allowed to wash down river. Use of mercury in the processing of ore increased, and mercury is found currently in area streams.

The upper Libby Creek drainage burned in 1889 and 1910, the valley was virtually stripped of all standing timber, and little habitat or fish resources were left to be affected by mining. Photos from the period indicate that Libby Creek was a wide, shallow stream with a cobble/gravel substrate. Howard Lake still remained a fishery after the 1910 fire. The few stream fish that remained after the 1910 fire probably were restricted to the headwaters, where only placer mines had been. Howard Lake and Libby Creek had regular stocking beginning in the late 1920s. In 1914, steam-operated mining equipment was used in Libby Creek. Large draglines and steam shovels dug into the bed and floodplain. Heavy equipment and hydraulic mining continued into the 1940s, after which time only a few placer mines remained. Additionally, timber was harvested on private land in the upper Libby Creek drainage in the 1950s. The first non-native fish (western coastal rainbow trout from California and brook trout from the eastern United States) were imported by rail in 1914 and released in local streams (USDA Forest Service *et al.* 1992).

Eighty years of mining and periodic wildfire in upper Libby Creek and the lower end of its tributaries limited available fish habitat throughout the Libby Creek drainage. The fish habitat that remained was concentrated in the upper headwaters of tributaries, including Bear, Ramsey, and Poorman creeks. Re-growth of conifers has begun to stabilize the stream system in the upper valley (USDA Forest Service *et al.* 1992).

3.6.3.9 Threatened and Endangered Fish Species

Bull trout occur in analysis area streams and are currently listed as threatened by the USFWS. The USFWS also has designated bull trout critical habitat in the analysis area in segments of Rock Creek, East Fork Rock Creek, Libby Creek, Poorman Creek, Ramsey Creek, and West Fisher Creek (Figure 56).

3.6.3.9.1 Description of the Population Area

Historically, bull trout were likely distributed throughout the Libby Creek, East Fork Bull River, Rock Creek, and Fisher River watersheds. The current bull trout populations within the analysis area are composed of both a resident and a fluvial/adfluvial (stream/lake) component (FWP 2008a). Bull trout have been reported from both upstream and downstream of the Libby Creek Falls on Libby Creek, as well as within Bear Creek, Poorman Creek, Ramsey Creek, East Fork Rock Creek, Rock Creek, West Fisher Creek, Fisher River, and the East Fork Bull River (Figure 56); (Western Resource Development Corp. 1989a; Chadwick Ecological Consultants, Inc. 2000; Kline Environmental Research 2004; FWP 2008a). Bull trout spawning has also been documented within the Libby Creek watershed, with redds located in Libby Creek (both upstream and downstream of the falls), Bear Creek, and possibly in Ramsey Creek (the redds located were not definitively determined to be bull trout redds). Additionally, redd surveys have documented bull trout spawning in the Fisher River, East Fork Bull River, and Rock Creek watersheds (Washington Water Power Company 1996; USFWS 2002).

3.6.3.9.2 Subpopulation Size

As summarized in section 3.6.3.5.1, *Libby Creek Drainage Fish* Populations, spawning surveys conducted from 1988 to 2004 identified bull trout redds during one or more of the surveys in reaches in Libby Creek, Ramsey Creek, and Bear Creek. Bear Creek appears to be used most frequently for bull trout spawning, with up to 36 redds identified during surveys.

Bull trout densities in the Libby Creek watershed ranged up to 13 fish/100 m based on data collected from 1989 through 2005 (Western Resource Development Corp. 1989; Kline Environmental Research 2004; Kline Environmental Research and Watershed Consulting 2005a; FWP 2008a). While limited data exist for the Rock Creek and East Fork Bull River watersheds, most survey data indicate relatively high densities of bull trout in these streams compared to streams within the Libby Creek drainage. Bull trout appear to be less numerous in the Fisher River watershed, but data are limited for this drainage. Based on these numbers and spawning survey data, the bull trout subpopulation, although viable, is small in the Libby Creek watershed. Rock Creek and the East Fork Bull River likely support larger subpopulations of bull trout.

In the East Fork Bull River, 24 to 101 juvenile bull trout were captured annually between 2000 and 2004, for a total of 327 trout. In Rock Creek, 17 to 55 bull trout were collected annually between 2001 and 2004, for a total of 137 trout over the 4-year period. These data support the contention that Rock Creek is secondary to the Bull River in terms of recruitment of juvenile bull trout to the Cabinet Gorge Reservoir, although Rock Creek has steadily contributed trout (USFWS 2006). Bull trout redds have been observed in the East Fork Bull River and Rock Creek. Redd surveys by Avista (Storaasli and Moran 2008) indicate that East Fork Bull River, and to a lesser extent Rock Creek, are two primary spawning streams that support the Cabinet Gorge bull trout population (Montana Bull Trout Scientific Group 1996).

3.6.3.9.3 Growth and Survival

Data to determine growth rates for the bull trout subpopulations within analysis area streams are limited. The only age and growth analysis data for the Libby Creek watershed were collected during the 1988 initial baseline data survey and were summarized in section 3.6.3.5.1, *Libby Creek Drainage Fish Populations*. Based on this analysis data, most bull trout within the Libby Creek drainage are young, as is typical for low-productivity mountain-headwater streams. Older bull trout were only found in the upstream portions of Libby Creek and Ramsey Creek, and in East Fork Rock Creek. Growth rates for all age classes were low, likely due to limitations caused by low nutrient concentrations. Data to determine survival rates for the Libby Creek drainage subpopulation are insufficient.

Bull trout growth in Rock Creek and the East Fork Bull River was relatively low when compared with other tributaries to the lower Clark Fork River (Washington Water Power Company 1996). Instantaneous survival rates for age III+ bull trout were 18 percent for the East Fork Bull River and 23 percent for Rock Creek. These survival rates were lower than the average for the other tributaries to the lower Clark Fork River (Washington Water Power Company 1996).

3.6.3.9.4 Life History Diversity and Isolation

Bull trout are widely distributed throughout the lower Kootenai River watershed, with spawning and rearing by migratory adults occurring in tributaries that drain British Columbia, Idaho, and Montana. The Libby Creek population has both a resident and a fluvial/adfluvial, migratory life history form. The resident population is isolated from the rest of the bull trout within and downstream of the analysis area by Libby Creek falls, which is located about 1.2 miles upstream of the Howard Creek confluence. The migratory population spends their adult lives in Kootenay Lake or the Kootenai River, with upstream migration limited by Libby Dam, which is impassable to bull trout moving upstream, but not downstream. Spawning and rearing of bull trout have been documented in Libby Creek and the Fisher River, as well as other Kootenai River tributaries (Western Resources Development Corp. 1989a; USFWS 2002; FWP 2008a). Specific spawning data within the upper Libby Creek watershed are limited, but the observation of redds has established that bull trout do use portions of Libby Creek, Bear Creek, and possibly Ramsey Creek for spawning (Western Resource Development Corp. 1989a; Dunnigan *et al.* 2005). It is not clear if these redds were from resident or fluvial bull trout.

Bull trout in the East Fork Bull River and Rock Creek are included in the Cabinet Gorge core area within the Lower Clark Fork River Recovery Unit (USFWS 2002), and are isolated from the bull trout populations in the lower Kootenai River watershed. East Fork Bull River and Rock Creek are considered important spawning streams for this subpopulation (Montana Bull Trout Scientific Group 1996) and redd surveys by Avista support this contention. Bull trout populations within these streams may include both resident life history forms and fluvial/adfluvial migratory life history forms (FWP 2008a); however, the occurrence of resident bull trout in East Fork Bull River is uncertain (Chadwick Ecological Consultants, Inc. 2000). Observations of smaller redds indicative of resident bull trout and observations of large bull trout that are presumed to be migratory fish based on their size indicate that both the resident and fluvial/adfluvial life forms exist in Rock Creek (Montana Bull Trout Scientific Group 1996). More recent research has shown radio tagged bull trout transported from Lake Pend Orielle moving to the East Fork Bull River. Genetic information, sampling surveys, and telemetry indicate this population is primarily a migratory population (Katzman and Hintz 2003).

The bull trout population in Rock Creek is considered to be composed primarily of resident fish (USFWS 2003). Migratory fish do use the stream as demonstrated by radio tagged bull trout tracked to this stream (Hintz and Lockard 2007). Two reaches of Rock Creek, including a reach located near the confluence with the Clark Fork River, are intermittently dewatered and may act as seasonal barriers to fish passage (USFWS 2007a; FWP 2008a).

3.6.3.9.5 Persistence and Genetic Integrity

The bull trout populations that occur in the Libby Creek and Fisher River watersheds are part of the Kootenai River/Kootenay Lake primary core area (USFWS 2002). A primary core area indicates that good connectivity exists within the area, with large lakes and migratory corridors present. Six local populations have been documented in the Kootenai River/Kootenay Lake core area, with one of these populations estimated as having greater than 100 individuals, and three others, including the population in Libby Creek, estimated as having numbers approaching 100 individuals. If a core area has five local populations with 100 or more spawning adults and 1,000 or more adult fish, it is assumed to consist of enough individuals to protect genetic integrity and be less vulnerable to the effects of environmental instability (USFWS 2002). Section 3.6.3.1.2, *Barriers to Fish* Passage discusses barriers on analysis area streams to bull trout. While the isolated, resident bull trout population that inhabits the upstream portion of Libby Creek has persisted for many years, it is more vulnerable to extirpation via catastrophic events such as droughts, landslides, floods, or fire than the trout in the watershed downstream of the falls.

The bull trout populations within the Lower Clark Fork Recovery Unit, which includes Rock Creek and the East Fork Bull River, continue to persist, although sometimes in low numbers, in the watersheds where they likely occurred historically. Migratory trout life history forms have largely been replaced by resident trout life history forms in many of the tributaries, limiting genetic diversity and increasing the risk of local extinctions (Montana Bull Trout Scientific Group 1996; USFWS 2002). The presence of migratory bull trout has been established in both Rock Creek and the East Fork Bull River (Washington Water Power Company 1996; Chadwick Ecological Consultants, Inc. 2000). Bull trout with migratory life histories are necessary for the long-term success of the species because generally they are more resilient and more resistant to environmental variation and stressors (Rieman and Mcintyre 1993; Montana Bull Trout Scientific Group 1996). The upstream and downstream transport program for bull trout conducted by Avista aids in ensuring the long-term success of this life history trait.

The presence of brook trout threatens the persistence and the genetic integrity of bull trout within the analysis area. The probability of hybridization and displacement from competition is high. The presence of brook trout has been documented downstream of the analysis area in the lower Libby Creek drainage for many years, and were first documented in upper Libby Creek drainage in 2004 and in the Fisher River drainage in 1986 (FWP 2008a). During the 2005 surveys of the Libby Creek drainage, brook trout were almost eight times as numerous as bull trout at the Libby Creek sites surveyed (Figure 53). Brook trout threaten the persistence and genetic integrity of bull trout through the probability of displacement by competition or hybridization. No genetic analyses have been performed on the bull trout within the Fisher River watershed to determine if hybridization has occurred. Genetic analysis in the upper Libby Creek drainage found no indication of hybridization (Arden *et al.* 2007). Brook trout hybridization is suspected in O'Brien Creek, a Kootenai River tributary located farther north in the basin. Additionally, a 25 percent hybridization rate was detected from a sample of 24 bull trout from the Kootenai River (USFWS 2002). The subpopulation of bull trout that inhabit Libby Creek upstream of Libby Creek Falls is

assumed to be protected from the threat of hybridization with brook trout because the barrier created by the falls prevents brook trout from accessing that portion of the stream.

Within the Cabinet Gorge core area, genetic analyses on bull trout from three reaches of the East Fork Bull River were conducted in 1993. Almost 60 trout were tested; none showed signs of hybridization. Brook trout are present in most streams in the lower Clark Fork River drainage that currently support bull trout, including Rock Creek and the East Fork Bull River. Additionally, brook trout are known to be extensively hybridized with bull trout in Mission Creek (USFWS 2002; FWP 2008a), a tributary to the Flathead River that is within the same Recovery Unit as the East Fork Bull River and Rock Creek.

3.6.3.9.6 Designated Critical Habitat

Within the mine analysis area, three segments of Libby Creek, and short segments of Poorman and Ramsey creeks are designated critical habitat within the Libby Creek drainage (Figure 56).The segments on Poorman and Ramsey creeks are at their confluence with Libby Creek. The longest segment on Libby Creek extends from the confluence with Howard Creek to downstream of Poorman Creek, and is about 3.5 miles. The Libby Adit and LAD Areas in all alternatives and the Libby Plant Site and Poorman Impoundment Site in Alternatives 3 and 4 are west of this segment. Another segment of critical habitat is found on MMC's property downstream of the Little Cherry Creek Impoundment Site. The third segment of Libby Creek in the analysis area is a short segment near the confluence with Hoodoo Creek, downstream of all facilities in all alternatives. A total of 14.4 miles of designated critical bull trout habitat, 9.9 miles of which are in the analysis area, occurs on Libby Creek and the two tributaries (Figure 56).

All segments of designated critical habitat on Libby Creek are on Montana's 303(d) list of water quality-impaired streams. Aquatic life support and cold-water fishery uses are only partially supported for this reach. Probable causes listed by the DEQ are alteration in stream-side or littoral vegetative covers, mercury exceedances, and physical substrate habitat alterations likely resulting from impacts from abandoned mine lands and placer mining. Historical effects of mining and periodic wildfire in upper Libby Creek have limited available fish habitat throughout the Libby Creek drainage. Recent habitat data on Libby Creek suggest that riparian vegetation and bank stability are improving in the area. Pool habitat and large woody debris, which are important components of bull trout habitat, are present throughout Libby Creek (Table 54 through Table 57).

Two segments of designated critical habitat, one 0.9 mile and the other 1.2 miles long, are found on West Fisher Creek. These two segments are along the Alternative E transmission line corridor. West Fisher Creek has pools and large woody debris throughout most of its length. The exception is near the mouth of the stream where it becomes very wide. Bank stability is variable, but there is adequate habitat to support fish through the reaches of critical habitat (Table 58).

Critical habitat in the Rock Creek drainage is designated at five separate locations. Four sections are located on the mainstem and one section is located on the East Fork (above the confluence with the West Fork) (Figure 56). The total amount of designated critical habitat on Rock Creek and East Fork Rock Creek is 2.9 miles (USFWS 2007a). All segments of designated critical habitat on Rock Creek are on Montana's 303(d) list. Probable causes for the Rock Creek impairment are other anthropogenic substrate alterations, with probable sources of these impairments listed as silvicultural activities. All five designated stream segments contain some, or all, of the critical elements that support bull trout. Two seasonally dewatered segments of the

mainstem of Rock Creek encompass all or portions of four of the five critical habitat sections. The extent of critical habitat area that is affected annually depends on year-round streamflow conditions. In most years, habitat is adversely affected to some degree due to the seasonal lack of connectivity preventing upstream movement of adult migratory bull trout. Annual subsurface streamflow conditions in summer and early fall severely affect the ability of bull trout to find suitable spawning areas. Consequently, it is likely that reproduction in most years is significantly limited (USFWS 2007a).

3.6.3.10 Sensitive Fish Species

Westslope cutthroat trout and interior redband trout are Forest Service sensitive species and inhabit streams within the analysis area.

3.6.3.10.1 Westslope Cutthroat Trout

Description of the Population Area

Historically, westslope cutthroat trout were likely distributed throughout the analysis area within the Kootenai and Clark Fork River watersheds. Based on the results of genetic analyses, no pure westslope cutthroat trout populations have been found to inhabit the Libby Creek watershed within the analysis area. The hybrid trout populations in Ramsey Creek, Bear Creek, Little Cherry Creek, and segments of Libby Creek downstream of the mine area include rainbow/westslope cutthroat and redband/westslope cutthroat trout hybrids (Kline Environmental Research 2004). The trout tissues tested showed only slight hybridization of the rainbow or redband trout with westslope cutthroat trout, containing 2 percent or less westslope cutthroat trout genes. Genetic analyses of westslope cutthroat trout in Bear Creek near the Libby Creek confluence indicated the fish are likely redband/cutthroat trout hybrids.

Results from genetic analyses indicated that the westslope cutthroat trout population in the East Fork Bull River is pure. Trout collected from Rock Creek also were found to be pure westslope cutthroat trout. Several trout collected from a section of East Fork Rock Creek near Rock Lake were found to be hybridized with Yellowstone cutthroat trout and rainbow trout. Likewise, genetic analyses on trout collected from Rock Lake indicated that all trout collected were westslope cutthroat trout/Yellowstone cutthroat trout hybrids (FWP 2008a).

In the Fisher River watershed within the analysis area, pure westslope cutthroat trout were collected from Miller Creek, and westslope cutthroat trout/rainbow trout hybrids were collected from near the mouth of Miller Creek (FWP 2008a). Pure westslope cutthroat trout have not been found in any other stream in the Fisher River watershed within the analysis area.

Based on these results, this species would not be impacted by the proposed activities within the Libby Creek watershed because pure westslope cutthroat trout are not present. They potentially could be affected from any activities within the Fisher River, East Fork Bull River, and Rock Creek watersheds.

Subpopulation Size

Limited survey data were available to indicate subpopulation size in the Fisher River, East Fork Bull River, or Rock Creek watersheds. None of the surveys conducted within the segment of the Fisher River within the reach potentially affected by the transmission line alternatives recorded any pure or hybridized westslope cutthroat trout, but survey data are limited. Likewise, while genetic analyses indicate that hybrid westslope cutthroat/rainbow trout inhabit West Fisher Creek,

no surveys reported any hybrid westslope cutthroat/rainbow trout. Surveys conducted in Miller Creek recorded westslope cutthroat trout and redband/westslope cutthroat trout hybrids, but did not give any density estimates. Relative abundance data from these surveys indicate that pure westslope cutthroat trout compose between 16 percent and 22 percent of the trout population in this creek, with hybridized redband/westslope cutthroat trout composing an additional 18 percent of the trout collected in one of these surveys (FWP 2008a). Within the Rock Creek watershed, a survey in three reaches of Rock Creek found westslope cutthroat trout at densities up to 79 trout/100 m. Other surveys also reported relatively high densities of westslope cutthroat trout within this watershed (Washington Water Power Company 1996; USDA Forest Service and DEQ 2001), and westslope cutthroat trout were the dominant species in this stream in most surveys. Hybrid westslope cutthroat trout were collected from the more upstream reaches of Rock Creek and in Rock Lake. The hybridization in analysis area streams may be more widespread than reported, because reliably distinguishing between pure and hybridized westslope cutthroat trout in the field is difficult. The genetic analysis indicates that the hybrid trout are composed of 93 percent westslope cutthroat trout genes (FWP 2008a).

Westslope cutthroat trout are also relatively abundant in the East Fork Bull River (Washington Water Power Company 1996; Horn and Tholl 2008). They were generally the dominant species in this upper reaches of this stream (Washington Water Power Company 1996; Chadwick Ecological Consultants 2000; Horn and Tholl 2008). Westslope cutthroat trout in the Rock Creek and East Fork Bull River watersheds appear to be viable and thriving.

Growth and Survival

Limited data are available on growth rates and age class structure of westslope cutthroat trout within the analysis area. Data collected in 1986 and 1987 in East Fork Rock Creek and Rock Lake showed few to no young-of-year fish (age I) (Western Resource Development Corp. 1989a). The trout collected from Rock Lake appeared to have an older age structure than those collected from East Fork Rock Creek, but likely this resulted from the different sampling methods employed to collect trout from the lake (Western Resource Development Corp. 1989a). Growth rates during these surveys were described as low in comparison to other tributaries within the lower Clark Fork River drainage. The instantaneous survival rate of 23 percent was similar to the average for these streams. The East Fork Bull River was surveyed during the same time frame, with the oldest trout collected in the age III+ class. Growth rates and the instantaneous survival rate (26 percent) were similar to the average for the other tributaries within the drainage (Washington Water Power Company 1996). Growth and survival rates in the Rock Creek and East Fork Bull River watersheds appear to be similar or slightly lower than other streams in the lower Clark Fork River drainage.

Life History Diversity and Isolation

Westslope cutthroat trout populations within the Fisher River, Rock Creek, and East Fork Bull River drainages likely consist of both resident and fluvial life history forms. Little survey data that document the presence or absence of natural barriers within any of these watersheds are available. The only documented barriers to fish passage in East Fork Rock Creek are in the upstream reaches near Rock Lake. The Bull River and East Fork Bull River have no known physical barriers that prevent trout from accessing these streams from the Clark Fork River (Washington Water Power Company 1996). The presence of migratory westslope cutthroat trout have been documented in the East Fork Bull River (Katzman and Hintz 2003). Dewatering at the mouth of Rock Creek isolate fish in Rock Creek seasonally.

Persistence and Genetic Integrity

Based on the data provided from a limited number of genetic analyses, westslope cutthroat trout populations in the Fisher River drainage are largely hybridized, except for a pure population in Miller Creek (FWP 2008a). Unless barriers prevent rainbow and redband trout from accessing the upstream reaches of Miller Creek, the trout in the more upstream reaches of Miller Creek are vulnerable to hybridization.

Trout collected nearer to the outlet of Rock Lake, while still predominately westslope cutthroat trout, have Yellowstone cutthroat trout and rainbow trout genes (FWP 2008a). All trout collected in Rock Lake were identified as westslope cutthroat/yellowstone cutthroat trout hybrids. The seasonally dewatered sections of Rock Creek at the confluence of the Clark Fork River (FWP 2008a) may aid in protecting the purity of the westslope cutthroat populations by acting as a barrier to trout moving upstream during some parts of the year. Barriers to upstream fish passage in Rock Creek are in the upstream Rock Creek Meadows reach and at the outlet of Rock Lake. These barriers do not prevent the movement of fish in a downstream direction, indicating that hybridization of the pure trout within these reaches is possible (Washington Water Power Company 1996).

Results of genetic analyses of trout in the East Fork Bull River indicate the population is pure, and seems to have a lower chance of hybridization occurring because no rainbow, redband, or Yellowstone cutthroat trout have been collected in the surveys of this stream. No physical barriers exist in the Bull River mainstem or the East Fork Bull River that prevent the rainbow trout and hybrid trout present elsewhere in the drainage from moving upstream to hybridize this population (Washington Water Power Company 1996).

The persistence of westslope cutthroat trout in these drainages is also threatened by the presence of brook trout and brown trout, which may outcompete westslope cutthroat trout for available resources or prey upon them. In the East Fork Bull River, brown trout appear to be flourishing, dominating the fish populations at downstream sites during most surveys (Washington Water Power Company 1996; FWP 2008a). In 2007, non-native salmonid suppression activities were initiated (Moran and Storaasli 2008).

3.6.3.10.2 Redband Trout

Description of the Population Area

Historically, redband trout were distributed throughout much of the analysis area. Based on fish distribution surveys, redband trout and their hybrids are the dominant trout species within the Libby Creek watershed as well as in the upstream segment of the Fisher River. There were no records of redband trout from the Rock Creek and East Fork Bull River drainages (Washington Water Power Company 1996; Chadwick Ecological Consultants, Inc. 2000; USDA Forest Service and DEQ 2001; FWP 2008a). Results of genetic analyses indicate that redband trout are largely hybridized throughout the Libby Creek watershed, but genetically pure redband trout have been collected from portions of Libby, Poorman, Bear, Ramsey, and Little Cherry creeks, and recently from the Fisher River (FWP 2008a).

No spawning surveys were available for redband trout. Fish distribution surveys and genetic analyses (Western Resource Development Corp. 1989a; Kline Environmental Research 2004; Kline Environmental Research and Watershed Consulting 2005a; Leary 2006) are the primary data for this subpopulation. Habitat surveys conducted in 1988 (Western Resource Development

Corp. 1989a) and in 2005 (Watershed Consulting and Kline Environmental Research 2005) supplement the fish distribution data.

Subpopulation Size

While no redband trout redd surveys have been conducted in the Libby Creek or Fisher River watersheds, fish distribution surveys have shown that redbands and their hybrids are the dominant trout species within the analysis area in both watersheds, with densities up to 102 trout/100 m (Kline Environmental Research 2005a). Based on these numbers, the mixed redband population is viable and thriving in the Libby Creek watershed, with small populations of pure redbands in all of Little Cherry Creek and in segments of Poorman Creek, Libby Creek, Bear Creek, and Ramsey Creek. While no abundance data were available for the Fisher River, the population in the upstream portion of this river consists of pure redband trout.

Growth and Survival

Data to determine growth rates for the Libby Creek drainage redband trout subpopulation are limited. The Libby Creek watershed within the analysis area is mainly inhabited by young trout, typical for headwater streams with low productivity. Available data have shown stable numbers of fish over time on streams where data were collected. Ramsey Creek was the only project stream in which older redband trout were collected. Growth rates for all age classes were low, probably due to low nutrient concentrations in these streams. Data to determine survival rates for the Libby Creek drainage subpopulation are insufficient.

Life History Diversity and Isolation

The Libby Creek and Fisher River watersheds' redband populations likely have both resident and fluvial, migratory life history forms. Redband trout have been collected in recent surveys from the segment of Little Cherry Creek located upstream of a series of fish barriers, which are considered impassable for trout. The redband trout population in this stream appears to be genetically pure based on the recent 2005 genetic analyses (Leary 2006). Genetic analyses of redband trout in Poorman Creek and the Fisher River also indicate that these populations are pure, possibly also as a result of barriers that keep the trout isolated from downstream hybridized populations. In the case of the redband trout present in the Libby Creek mainstem and the Fisher River, complete isolation from other rainbow, westslope cutthroat, or hybrid trout is unlikely because these other trout species have been identified in tributaries within the analysis area (FWP 2008a). Migratory redband trout probably persist in the remainder of the Libby Creek watershed not isolated through barriers, as well as in the Fisher River watershed.

Persistence and Genetic Integrity

Based on data provided from a limited number of genetic analyses, the redband trout population within the Libby Creek watershed consists mostly of redband/cutthroat and redband/rainbow trout hybrids. Some genetically pure redband trout have been collected in Libby Creek. Rainbow trout are stocked annually in Howard Lake (FWP 2008a) and likely access Libby Creek and its tributaries through Howard Creek. Genetic analyses have also shown that the redband populations in Ramsey Creek and Bear Creek are largely hybridized to a lesser extent with both rainbow and westslope cutthroat trout. Non-hybridized redband trout populations do persist in Poorman Creek and Little Cherry Creek, possibly due to the presence of barriers to fish moving upstream from Libby Creek. Leary (2006) reviewed the 1991, 1992, and 2005 genetic analyses results from trout in Little Cherry Creek and noted that substantial genetic changes had been observed in the redband trout population over a relatively short time period. These changes suggest there is a low

effective population size for redband trout in Little Cherry Creek. Non-hybridized redband trout also inhabit the upstream segment of the Fisher River, but they are likely vulnerable to hybridization because westslope cutthroat trout, rainbow trout, and hybrid trout exist in tributaries to this segment of the Fisher River and in downstream segments.

3.6.3.11 Tribal Treaty Rights

The Hellgate Treaty of 1855 reserved for the Kootenai Nation, among other rights, "the right to fish at all usual and accustomed places….on open and unclaimed lands." The KFP recognizes these treaty rights, and allows the Flathead/Kootenai-Salish Indian tribes to fish within the KNF. Additionally, the American Indian Religious Freedom Act allows Native Americans access to sites within the KNF that are still in use. Section 3.5, *American Indian Consultation* discusses American Indian rights.

3.6.3.12 Existing Watershed Conditions

The potentially affected threatened and sensitive fish species in analysis area streams include bull trout, redband trout, and westslope cutthroat trout. This analysis will focus on their habitat needs. Section 3.11, *Surface Water Hydrology* gives a more thorough review of the existing hydrologic conditions in the Libby Creek watershed.

The variables analyzed correspond to habitat indicators listed on the USFWS matrix for bull trout (USFWS 1998). Existing conditions for each habitat indicator are described, with the assessment including the segments of the Libby Creek, Fisher River, East Fork Bull River, and Rock Creek watersheds that are within the analysis area. Sufficient stream habitat data are available for many of the habitat indicators for the Libby Creek watershed, but are limited for the Fisher River, East Fork Bull River, Poorman Creek, and Rock Creek watersheds. Major assessments of the drainage occurred for the 1992 Montanore Project Final EIS in 1988 (Western Resource Development Corp. 1989a) and as an update of the 1992 Final EIS data in 2005 (Kline Environmental Research and Watershed Consulting 2005a; Kline Environmental Research 2005a, 2005b, 2005d; Kline Environmental Research *et al.* 2005; Watershed Consulting and Kline Environmental Research 2005). Habitat surveys at a more limited number of sites also were conducted before and after the baseline surveys in 1988, as summarized by Kline Environmental Research (2004) and USDA Forest Service (2005).

3.6.3.12.1 Temperature

Riparian harvest and channelization (especially on Libby Creek) on National Forest System lands and other private lands along the mainstems of streams in the analysis area has occurred for mining, land development, and land management. Grazing occurs only on private property in the Libby Creek drainage. It is likely that there has been a noticeable change in temperature as a result of timber management and channelization on lands in the analysis area. Water temperature monitoring has occurred on both Libby Creek (two sites, upper and lower) and West Fisher Creek (at one site near the confluence with the Fisher River). Temperature data indicate that the lower and middle segments of Libby Creek and the lower segment of West Fisher Creek are warmer than 15ºC, a maximum limit for salmonids, for numerous days during the summer months.

Temperature data collected during the 2005 field season in the Libby Creek watershed during baseline flow conditions by Kline (2005) ranged from 5°C to 19°C, with mean stream temperature at each site ranging from 9°C to 13°C in 2005. These data were from nine temperature loggers placed at sites L1, L10, Be2, LC1, LC3, Po1, Po2, Ra2, and Ra3 (Figure 53).

Temperature data also were collected in 1994 in the East Fork Bull River and Rock Creek. Temperatures averaged 6°C in the East Fork Bull River and 7°C in Rock Creek, and ranged from less than 1°C to 17°C in these streams (Washington Water Power Company 1996). Temperatures recorded in 2002 at the mouth of the East Fork Bull River had a maximum temperature of 15°C (Liermann and Tholl 2003).

Bull trout require water temperatures ranging from 2°C to 15°C, with temperatures at the low end of this range required for successful incubation (USFWS 1998). While based on limited data, the temperatures in most stream reaches were within this range for most of the year. Maximum water temperatures were occasionally above 15°C at the most downstream Libby Creek site and the East Fork Bull River site during the summer months. Temperatures occasionally exceed the maximum water temperatures for fish spawning and rearing in the analysis area (MMI 2006).

3.6.3.12.2 Sediment

Substrate composition is dominated by cobble and gravel in most surveyed sites in the analysis area (Watershed Consulting and Kline Environmental Research 2005). The mean percent fines (described in the report as fines less than 6.25 mm) in gravel at each site ranged from 14.6 percent at the lowest Libby Creek site to 43.0 percent at the Rock Creek site (Washington Water Power Company 1996; Wegner, pers. comm. 2006a) (Table 57).

Incubation of bull trout embryos begins to decrease substantially when more than 30 percent of the sediment is smaller than 6.35 mm in diameter. There is an inverse relationship between the percentage of fine sediment in the incubation habitat and survival until emergence (Weaver and Fraley 1991). Based on these data, sediment is not currently a limiting factor in most stream reaches within the Libby Creek drainage in the analysis area. Sediment may be more of a factor in Rock Creek, where sediment levels were described as being relatively high compared to other lower Clark Fork River tributaries (Kline Environmental Research and Watershed Consulting 2005b).

3.6.3.12.3 Nutrients and Contaminants

The Libby Creek reach from 1 mile upstream of the Howard Creek confluence to the U.S. 2 Bridge is included on Montana's 303(d) list for water quality impaired streams. Use as a drinking water supply is not supported as a beneficial use, and aquatic life support and cold-water fishery uses are only partially supported for this reach. Probable causes listed by the DEQ are alteration in stream-side or littoral vegetative covers, mercury exceedances, and physical substrate habitat alterations likely resulting from impacts from abandoned mine lands and placer mining. During the 1988-1989 monitoring period, mercury concentrations in surface water exceeded human health standards occasionally, but have generally been below detection limits in later sampling. Mean mercury concentrations in fish tissues analyzed from that same time period were below the EPA's water quality criteria for the protection of human health for methylmercury.

The Fisher River from the confluence of the Silver Butte Fisher River and the Pleasant Valley Fisher River to the confluence with the Kootenai River is included on Montana's 303(d) list, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Fisher River impairment are a high flow regime and high lead concentrations, with probable sources of these impairments listed as channelization, grazing, road runoff, road construction, silvicultural activities, and streambank modification and destabilization.

Rock Creek from the headwaters to the mouth below Noxon Dam is also listed, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Rock Creek impairment are other anthropogenic substrate alterations, with probable sources of these impairments listed as silvicultural activities. TMDLs are not required on Rock Creek because no pollutant-related use impairment has been identified.

Existing surface water conditions for metals occasionally exceed the chronic ALS for cadmium, copper, lead and zinc at various locations throughout the watershed (Geomatrix 2007f). Metal concentrations in analysis area streams are variable. For example, about half of the surface water samples collected in Libby Creek had copper concentrations below the detection limit, with detected concentrations ranging above the chronic and acute ALS. The occasionally elevated concentrations suggest that existing concentrations of these metals may pose risks to aquatic life presently inhabiting these streams. The presence of diverse size classes of fish in the Libby Creek watershed streams suggests concentrations of these metals are not contributing to acute toxic effects for fish populations. It is not known whether chronic metal toxicity may be contributing to low population densities in these streams.

Generally, nutrient and most metal levels in analysis area streams are low. Nitrate/nitrite levels in Libby Creek downstream of the Libby Adit were elevated from 1991 through 1993, but concentrations declined after adit construction ceased.

3.6.3.12.4 Physical Barriers

Presently, man-made barriers, natural barriers, and small stream size of many tributaries limit bull trout distribution and connectivity in the Libby Creek watershed. A natural 39-foot waterfall on Libby Creek upstream of the Howard Creek confluence is an upstream barrier to all fish under all flow conditions. This barrier isolates the bull trout population upstream of these falls to a portion of the watershed. Natural barriers on Little Cherry Creek, Poorman Creek, and Ramsey Creek cause portions of these tributaries to be inaccessible to fish from Libby Creek (Kline Environmental Research 2005a). Little Cherry Creek provides the least amount of habitat for fish moving from Libby Creek because of the close proximity of natural barriers to the confluence of Little Cherry Creek and Libby Creek. Culverts may limit the passage of juvenile fish on Little Cherry Creek and Poorman Creek. For the most part, the connectivity and availability of bull trout habitat is not significantly limited by man-made barriers in the portion of the Libby Creek watershed within the analysis area.

No barriers have been described in the East Fork Bull River and the Fisher River, but no surveys specifically assessing fish passage were available. In West Fisher Creek drainage, the mouth of the stream has become extremely braided. There are numerous small side channels connecting the Fisher River with West Fisher Creek. These channels allow minimal passage for large migratory fish. These fish stack up in the Fisher River under the U.S. 2 Bridge and wait for months until rain brings enough water to open up access into the drainage. Barriers to upstream fish migration do exist on East Fork Rock Creek, but the barriers are located upstream in the Rock Creek Meadows reach and the outlet to Rock Lake. Additionally, these barriers do not prevent downstream fish movement (Washington Water Power Company 1996). Two reaches of Rock Creek near the mouth are subject to periodic dewatering, which act as a barrier to fish during low flow periods (FWP 2008a).

3.6.3.12.5 Substrate

The dominant substrate classes in the Libby Creek watershed are cobble and gravel (Watershed Consulting and Kline Environmental Research 2005). Substrate in the East Fork Bull River is primarily gravel and rubble, while the substrate in Rock Creek is predominately rubble, cobble, gravel, and boulder (Washington Water Power Company 1996). Substrate embeddedness in rearing areas has not been quantified in most of the analysis area. Embeddedness in Little Cherry Creek was low for most of the stream length, but high through a 1,000-foot reach about 3,300 feet upstream of the Libby Creek confluence (Kline Environmental Research 2005a).

3.6.3.12.6 Large Woody Debris

The number of pieces of LWD per mile ranged from 22 to 338 within the Libby Creek watershed (Watershed Consulting and Kline Environmental Research 2005). LWD was most abundant in Little Cherry Creek, but was found at densities higher than 105 LWD/mile at all sites except for four of the Libby Creek sites (Figure 53). Surveys indicated that adequate cover in the form of LWD was available for bull trout within the East Fork Bull River and Rock Creek watersheds. An average of 243 pieces of LWD/mile and 274 pieces of LWD/mile were counted in the Rock Creek and East Fork Bull River reaches surveyed (Washington Water Power Company 1996). Based on these data, the amount of large woody debris within the analysis area is sufficient to provide bull trout with adequate cover in most reaches. The RMO for LWD differs between stream size classes, but streams in the analysis area did meet the RMO for LWD, with the exception of one site on West Fisher Creek in 1996 (Table 58).

3.6.3.12.7 Pool Frequency

Most of the tributaries within the Libby Creek drainage had a fairly high number of pools, with the number per mile similar to values recommended by the USDA Forest Service (1998a) to provide sufficient bull trout habitat. The mainstems of Libby Creek and West Fisher Creek are generally lacking in pools. Most tributary streams seem to be mostly meeting the RMO, having adequate pools (USDA Forest Service 1995). With the past history of management in RHCAs, the high densities of road in the RHCA, and the large amounts of bedload transport in these streams, it is highly unlikely that many pools will be naturally generated in the mainstems of these drainages to satisfy this RMO. Pool generation in small streams is directly related to production of LWD in RHCAs. As trees fall into the stream, they modify streamflows in such a way that creates pools. The lack of LWD causes stream velocities to be faster and more direct, resulting in a lack of scoured pools. Although the RMO for LWD was met in many small streams, future production of LWD in RHCAs of larger streams will be limited due to the high densities of road and past timber harvest. Fine sediment will continue to be produced from timber management and roading in the drainages, which will continue to negatively impact pools.

3.6.3.12.8 Pool Quality

Quality pools are generally over 3 feet deep and have sufficient cover to hide fish. Measured pools during fisheries habitat surveys generally had adequate cover but lacked depth. Attempts to enhance pools in Libby Creek (mostly by FWP) have not been successful. Constructed pools were destroyed by high peak flows in the spring of 2007. The KNF constructed some pools and completed bank stabilization work on 3,800 feet on West Fisher Creek in 1997. The project is showing signs of stress from high flows and will need future work to further stabilize the area. High rain-on-snow events and active channel migration in these streams will continue to move large amounts of bedload and create channel widening. Loss of LWD and impacts from private

land will continue in the RHCAs of both drainages. As long as conditions do not change, this habitat characteristic will not meet RMOs.

The downstream Libby Creek site had the highest number of deep and large pools per mile of the analysis area streams. No other site had a significant number of deep pools (described as pools with a maximum depth greater than 5.2 feet), although large shallower pools (with depths greater than 2.6 feet and covering an area of greater than 215 square feet) were found on several Libby Creek sites, the Bear Creek site, and the two downstream Ramsey Creek sites (Watershed Consulting and Kline Environmental Research 2005). Some stream reaches within the analysis area may provide poor cover for bull trout due to the limited number of pools of sufficient depth and area. Pool quality data were not available for the East Fork Bull River, Rock Creek, or the Fisher River watersheds.

3.6.3.12.9 Off-Channel Habitat

Off channel habitat is found in side channels, tributary streams, and springs in the RHCAs of the mainstems of analysis area streams, and provides additional habitat for fish. The availability and type of habitat varies by stream in the analysis area. The analysis area supports classic mountain streams with moderate gradients and moderate entrenchment ratios. This changes to deeply incised boulder/bedrock-dominated streams in the headwaters and gentler gradient wider floodplains with low incision ratios in the lower segments of the larger streams. The analysis area contains almost every type of stream channel on the KNF. An extensive amount of off-channel habitat is found in the analysis area. The high densities of road in the RHCAs limit the streams' ability to make adjustments and create off-channel habitat, disrupting the long-term stability of this type of habitat.

Off-channel habitat is somewhat limited in some stream segments within the Libby Creek watershed. Several off-channel pools/backwaters were noted in Little Cherry Creek, primarily in the more upstream reaches (Kline Environmental Research 2005a). Multiple side channels were documented in Bear Creek during the 2005 survey, which could provide habitat for juvenile salmonid rearing (Watershed Consulting and Kline Environmental Research 2005). No other off-channel habitat has been documented in analysis area streams.

3.6.3.12.10 Refugia/Prime Habitat

Very few areas of high quality (prime) habitat are in the analysis area due to extensive riparian roading, past mining practices, and timber harvest in the lower portions of analysis area streams. Surveys have found that streams partially meet RMOs for pool quantity. Streams in the CMW portion of the analysis area are considered prime habitat. No timber management has occurred on these streams and human impacts are almost non-existent.

Only limited areas of diverse and high quality habitat exist over most of the analysis area in the Libby Creek watershed. Availability of habitat in the tributaries for fish moving from Libby Creek is limited by barriers, particularly in Little Cherry Creek (Kline Environmental Research 2005b). In 2002, the FWP completed stream restoration work on a segment of Libby Creek downstream of the Howard Creek confluence. The goal for this restoration project was to increase habitat quality for salmonids throughout this reach by increasing sinuosity, excavating depositional areas, and installing structures to increase bank protection, bank stabilization, gradient control, and pool habitat. The riparian vegetation was also restored (Dunnigan *et al.* 2003; Kline 2004).

A channel restoration project in East Fork Bull River was completed in 2001. Over 985 feet of the stream were restored by returning a braided channel to a single channel through the construction of rootwad and log revetments (logs anchored against the streambank to buffer stream energy), the placement of large woody debris weirs, and the revegetation of the streambanks and floodplain. The goal of this restoration was to make the channel more capable of transporting sediments and conveying bankfull flows (Avista Corp. 2007; FWP 2008a). The channel has migrated to the opposite bank, so this section is currently dry. Additional work has been completed upstream of this section which should reduce sediment in the lower reaches of the East Fork Bull River (Carlson, pers. comm. 2008).

3.6.3.12.11 Pool Width/Depth Ratio

Most measured pools on the lower segments of stream channels in the analysis area are shallow and wide. Pools measured in headwater reaches are narrow and deep. Pools in the mainstems of larger analysis area streams have high peak flows from spring runoff and rain-on-snow events. These high flows coupled with high bedload and the relatively wide floodplains make pool creation and maintenance extremely difficult. Based on the data collected in 2005 (Watershed Consulting and Kline Environmental Research 2005), the average wetted width to maximum depth ratio in scour pools within each reach in the Libby Creek watershed range from 6.5 to 11.2. All analysis area streams have ratios less than 10 except for Ramsey Creek, indicating that pools exist within the Libby Creek watershed in the analysis area of sufficient depth to provide refuge for larger migratory fish and rearing habitat for the young of year fish and sub-adults. For the Fisher River, reaches with pools present have ratios that range from 16.9 to 3.2, suggesting that some areas may not provide sufficient refuge for larger fish or rearing habitat for young of the year fish. These higher ratios are generally in the lower reaches of the Fisher River. Miller Creek had ratios under 10 except in the very lowest reach, indicating that pools exist within the Libby Creek watershed in the analysis area of sufficient depth to provide refuge for larger migratory fish and rearing habitat for the young of year fish and sub-adults.

3.6.3.12.12 Streambank Conditions

Stable stream banks have greater than 80 percent linear stability. Libby Ranger District surveys found bank stability to be very good in all streams in the analysis area. Some measured reaches showed unstable bank conditions, but overall, streams in the analysis area are in good shape. Stream bank vegetation tends to become disturbed and stream bank sediment is readily available to be deposited into the stream. Most streams are in good condition, although rain-on-snow events and high spring peak flows may destabilize banks. Larger streams in the analysis area show signs of high flows destabilizing banks, while smaller streams are more armored and have resisted bank instability.

Bank stability was described as high within all surveyed stream reaches in the Libby Creek watershed, ranging from 99 to 100 percent stable banks (Watershed Consulting and Kline Environmental Research 2005), and should not be a factor in limiting available trout habitat. Bank stability was also described as stable in Rock Creek and the East Fork Bull River (Washington Water Power Company 1996). Portions of Libby Creek and other analysis area streams have been cited as having accelerated bank erosion, altered riparian zones, and reduced high quality habitat for salmonids due to human-caused disturbances such as logging, mining, riparian road construction, and stream channel manipulation (Washington Water Power Company 1996; Dunnigan *et al.* 2004). Habitat restoration projects have focused on improving some of these segments.

3.6.3.12.13 Floodplain Connectivity

Braiding is common throughout the mainstems of Libby Creek, West Fisher Creek, and Fisher River. Braiding occurs in streams with wide floodplains and large amounts of bedload. The bedload is moved during high flows, and can cause channels and associated wetlands to become disconnected from the main channel during low flows. Significant changes in riparian value and function due to channelization, land development, timber harvest, road construction, and mining, have contributed to destabilization of stream channels.

No specific data on floodplain connectivity were available for analysis area streams. Habitat surveys in the Libby Creek watershed stated that the channel capacity for most streams in the analysis area was inadequate or barely contained peak flows, with overbank flooding occurring occasionally or frequently (Kline Environmental Research 2004; USDA Forest Service 2005). Overbank flooding is considered necessary for maintaining wetland functions, riparian vegetation, and succession (USFWS 1998). Assessing floodplain connectivity in headwater mountain streams is complicated by the fact that they are usually restricted by a narrow, frequently incised mountain valley configuration and may not have a classic “floodplain.”

3.6.3.12.14 Change in Peak/Base Flows

Peak streamflows occur annually between April and June, with the highest flows most often occurring in May, then in April. Section 3.11.3.3.2, *Streamflow* discusses peak flow in analysis area streams. Typically, smaller, short-term increases in streamflow occur in October through March due to precipitation and snowmelt events. Libby Creek, Miller Creek, and West Fisher Creek have highly variable flow regimes, with flooding regularly occurring resulting in annually high suspended sediment levels, and high bedload movement. Since the turn of the century, timber harvest, road construction, mining, and human development have changed watershed character and, as a result, the watershed’s response to weather events. Various stream reaches have become intermittent in nature due in part to the large depositions of bedload, channel braiding, and widening. While Libby, Miller, and West Fisher creeks naturally have high peak flows during spring snow melt and rain-on-snow events, past human activities, such as instream mining, timber management, and road construction in riparian areas, may intensify damage to these streams caused by peak flows. The range of measured minimum and maximum streamflows is provided in Table 84 in section 3.11, *Surface Water Hydrology*.

3.6.3.12.15 Increase in Drainage Network

Drainage network is the network of streams within the watershed. There are no direct measurements of an increase in drainage network for analysis area streams. Human-caused disturbances such as logging, mining, riparian road construction, and stream channel manipulation have been cited as causing accelerated bank erosion, altered riparian zones, and reduced high quality habitat for salmonids within some segments of analysis area streams (Washington Water Power Company 1996; Dunnigan *et al.* 2004). These data indicate that there has likely been an increase in the drainage network within the analysis area. Road densities in the Libby Creek and West Fisher Creek drainages are considered high. Road failures have been a common occurrence throughout these drainages and their tributaries probably due to high precipitation events in the analysis area, rapid snowmelt and runoff from high elevation areas, and rain-on-snow events. Road and bridge failures have been an annual occurrence due in part to the volatile nature of these precipitation events. Sediment input due to road surface and ditch erosion is high. Road systems run parallel to or traverse every major tributary and the mainstems of Libby

Creek and West Fisher Creek. Many of these roads have been in place for decades, constructed to mining locations in the late 1800s and early 1900s.

3.6.3.12.16 Road Network

Roads and trails run parallel to most of the length of Libby Creek, Miller Creek, West Fisher Creek, East Fork Rock Creek, and their major tributaries. Many of these roads were constructed within the RHCAs. Some of these roads were originally constructed in the early 1900s to low standards and maintained infrequently. Impacts to streams associated with these roads include increased sedimentation, water routing down ditch lines, road stream crossing failures, hill side slumping, and removal of riparian vegetation due to road construction.

3.6.3.12.17 Riparian Habitat Conservation Areas

Timber harvest, mining, livestock grazing, road construction, and other human-caused disturbances have altered limited reaches of riparian zones in some areas of the Libby Creek, Rock Creek, East Fork Bull River, and Fisher River watersheds. Roads have been constructed within the RHCAs throughout the analysis area watersheds. RHCAs are shown in Figure 54.

3.6.3.12.18 Disturbance History and Regime

Disturbance regime refers to any natural disturbances that were present historically in the analysis area. Natural disturbance regimes are highly variable in analysis area drainages. Natural disturbance regimes include large fluctuations in runoff, such as rain-on-snow events and high peak flows during snow melt. Catastrophic disturbances are common, including flood events, high bedload movement and deposition, channel braiding, and mass wasting. The drainages are moderately prone to rain-on-snow floods. Windstorms resulting in blowdown have been minor and are generally associated with clearcutting activities. Although a large portion of the analysis area burned in 1889 and 1910, no major wildfires have occurred in several decades.

3.6.3.13 Integration of Species and Habitat Conditions

The quality of the bull trout habitat throughout the analysis area, especially in the larger tributaries, has been compromised by land development (particularly lower in the Libby Creek drainage), mining, and road construction in riparian areas along the mainstem of the streams. Disturbance over the past 10 to 20 years has included natural fires, large windstorms, 100-year flows and rain-on-snow events. Impacts to stream channels and fish habitat have increased and include mass wasting, road culvert and bridge blowouts, bedload deposition, channel aggradation (build up of bedload) and degradation (down cutting) and flooding. Data on bull trout are fairly limited because, until recently, the major emphasis was on eliminating bull trout from local streams. Bull trout were viewed by some as undesirable bull trout prey upon small species of desirable sport fish.

The bull trout population in the Libby Creek drainage within the analysis area is currently at risk from the threat of hybridization and competition with the non-native brook trout moving into the area. Areas of high quality trout habitat in the Libby Creek watershed are limited. Bull trout have been routinely observed within the analysis area, but they persist only at low densities.

Bull trout appear to be found in higher densities in the Rock Creek and East Fork Bull River drainages, but as with the Libby Creek population, they are at risk from hybridization and competition with brook trout. Brown trout are also present in the East Fork Bull River drainage, and while they present no risk of hybridization with bull trout, they can pose a risk to the bull

trout population through competition for resources. Non-native suppression has been initiated to lessen this threat (Moran and Storaasli 2008). Logging, grazing, and wildfires have affected significant portions of the riparian zones in these streams (Washington Water Power Company 1996). The Fisher River is a migratory corridor for populations of bull trout. West Fisher Creek is a priority watershed. Bull trout occur in the stream and are at risk from competition for resources. The two segments of designated critical habitat on West Fisher Creek have adequate habitat to support bull through these reaches (Table 58).

Redband trout habitat has been similarly influenced by past mining efforts and other disturbances, but the largest threat to the redband trout is hybridization with introduced rainbow trout and native westslope cutthroat trout. Based on results from genetic analyses conducted in 1991 through 2005 (FWP 2008a), most of the redband trout population within the Libby Creek watershed is at least slightly hybridized, with pure populations existing in small tributaries where barriers are thought to isolate them from mainstem populations. While they have been observed regularly within all the analysis area streams within the Libby Creek watershed, redband trout are found at relatively low densities.

Redband trout are not found in the Rock Creek or East Fork Bull River watersheds, but pure redband trout are found in the Fisher River drainage, including West Fisher Creek. As with the Libby Creek watershed, these fish are at risk from hybridization because the trout in the segment of the Fisher River downstream of the analysis area and in some of the tributaries are hybridized.

In the analysis area, westslope cutthroat trout are known to be present in the Rock Creek and East Fork Bull River watersheds and Miller Creek. In the Libby Creek drainage westslope cutthroat trout are hybridized. As with redband trout, they are mainly at risk from hybridization and competition with introduced trout species. In East Fork Rock Creek, hybridization with rainbow trout and Yellowstone cutthroat trout is occurring in the upstream reaches, and no barriers have been identified that would protect the remaining genetically pure trout from these trout moving downstream. While the most recent genetic analyses have indicated that the westslope cutthroat population in the East Fork Bull River is pure, no barriers to protect these trout from hybridization have been observed. Westslope cutthroat trout densities are higher in these watersheds than redband or bull trout densities, indicating that the westslope cutthroat trout population is less at risk of extirpation in these streams.

3.6.4 Environmental Consequences

3.6.4.1 Alternative 1 – No Mine

Under this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

Without mine development, aquatic populations and stream habitat would remain unchanged from existing conditions. Productivity of fish and other aquatic life in analysis area streams would continue to be limited by past natural and human-caused adverse habitat changes, by naturally

low nutrient concentrations, and by natural habitat limitations from climatic and geologic influences.

Bull trout populations would continue to be marginal and the habitat in need of restoration work. Bull trout populations would be susceptible to decline or disappearance due to hybridization with introduced salmonids, competition with brook trout and other trout present in the analysis area, or from land use disturbances. Redband trout and westslope cutthroat trout also would continue to be subject to population declines, mainly due to the threat of hybridization from introductions of non-native salmonids. Improvements in habitat quality and productivity due to natural processes over time would potentially be adversely affected by the cumulative effects of continued forestry activities. Past, current, and future placer mining, continued recreational use, and other reasonably foreseeable actions would continue to affect fish populations.

3.6.4.2 Alternative 2 – MMC's Proposed Mine

Development of the Montanore Project would require construction of project facilities, including a mill, tailings impoundment, adits, access roads, and transmission lines. For Alternative 2, MMC's proposal, the mill and mine production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile from the CMW boundary. An additional existing adit on private land held by MMC in the upper Libby Creek drainage and an adit on MMC's private land east of Rock Lake would be used for ventilation. The proposed Rock Lake Ventilation Adit would be on a steep, rocky slope about 800 feet east of and 600 feet higher than Rock Lake. Because the total disturbance area for this adit would be small (about 1 acre), any effects would be minor and are not discussed further. A tailings impoundment would be constructed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek would be used for discharge of water through land application.

Potential impacts to fish and other aquatic life in the Libby Creek, Rock Creek, and East Fork Bull River drainages from the various proposed alternatives for the Montanore Project can be grouped under six general categories: changes in sediment delivery, changes in water quantity, changes in water quality (nutrient and toxic metals levels), changes in toxic metal concentrations in fish tissues, effects on fish passage, and effects on threatened, endangered or sensitive species. These effects will be addressed individually for each alternative.

3.6.4.2.1 Sediment

Construction and Operation of Mine

Streams

Possible sediment sources would include new road construction, road maintenance, sanding, and plowing, facilities construction, transmission line construction, existing road upgrades, timber and vegetation clearing, soil stripping, construction and use of the diversion and drainage channels for the tailings impoundment, excavation of borrow areas, stockpiling of excavated soils, and tree thinning in LAD Areas. The highest risk of increased sediment would occur during the construction phase of the mine, when trees, vegetation, and/or soils were removed from many locations for mine facilities and roads.

Any potential sediment increase from Alternative 2 would only affect analysis area streams within the Libby Creek watershed. No surface disturbances other than the ventilation adit in the

Rock Creek drainage would occur in the Rock Creek or East Fork Bull River drainages. Ventilation adit construction would not generate significant sediment.

Periodic short-term increases in the amount of sediment would occur in streams in the Libby Creek watershed. Several structures are planned to reduce or eliminate sedimentation increases to meet the INFS riparian goal. INFS designates that the integrity of the sediment regime of the riparian and aquatic ecosystems should be maintained. Based on the use of BMPs and other design criteria, sediment increases would have minimal effects on analysis area streams under most conditions.

The plant facilities, adits, and tailings impoundment would contain features that route all water and sediment to sediment traps or ponds designed to hold runoff flows from a 10-year/24-hour storm event. In the case of larger storms, overflows from these sediment ponds would be directed into Ramsey and Poorman creeks, and would cause short-term increases in sediment in these creeks. The high streamflows present during such an event would likely distribute much of the sediment well downstream to be deposited in floodplains or low gradient stream reaches, or transported to the Kootenai River. Any sediment flushed out of the Libby Creek watershed into the Kootenai River would settle out rapidly and would have negligible effect on aquatic resources or habitat.

Tree thinning is planned within the LAD Areas to allow for effective use of the sprinkler system. Clearing prior to construction and resulting road construction usually results in an increase in the amount of sediment delivered to streams. All clearing prior to construction at the LAD Areas would be located 300 feet or more from Poorman and Ramsey creeks. At MMC's proposed application rates, the agencies' analysis shows that surface runoff would occur (see section 3.10.4, *Environmental Consequences*). MMC indicated that sprinklers within 100 feet of ephemeral streams would be shut off during periods of surface water runoff and MMC would not be allowed to operate the LAD Areas in a manner that produces runoff or increases in spring flow. With these measures in place, minimal increases in sediment directly to Poorman or Ramsey creeks from tree thinning are predicted.

The Little Cherry Creek Diversion Channel would be designed to convey the 6-hour Probable Maximum Flood flows, while the riprap that lined the channel sides would be designed for the 100-year flood flows. While these measures would minimize erosion, some increased sedimentation in the unnamed tributary and Libby Creek is expected. If substantial erosion were observed once the diversion channel was operational, additional erosion structures would be constructed as needed. Borrow areas within the diversion dam disturbance area also would serve as sources of sediment to streams. Collection ditches/berms would be installed around soil stockpiles to reduce soil erosion and loss, and to limit any sedimentation impacts. Additionally, interim and concurrent reclamation would be employed where possible in all areas to reduce sediment loading and enhance site stability.

New road and bridge construction would be required in some areas within the Libby Creek watershed, and other roads would be reconstructed. Road construction and reconstruction is often considered the largest source of sediment in mining and timber harvest areas due to the removal of vegetation and construction of cut and fill slopes that expose large areas subject to erosion (Belt *et al.* 1992). BMPs would be used during road construction to reduce the amount of sediment reaching streams. Although BMPs and other erosion control methods would be used, roads would still serve as a source of sediment (Belt *et al.* 1992). Some sedimentation from road

construction and reconstruction would be likely, with the most increases occurring at stream crossings in Ramsey Creek, Poorman Creek, Bear Creek, and Libby Creek.

Alternative 2 would disturb 253 acres within RHCAs on National Forest System lands; 148 acres of other riparian areas on private lands would be disturbed (Table 63). Roads would be constructed or reconstructed within the RHCAs of Little Cherry, Libby, Bear, Poorman, and Ramsey creeks, as well as unnamed tributaries. Most of the roads reconstructed are existing roads that cross a RHCA only at a stream crossing, but segments of existing roads parallel the RHCAs along Ramsey and Libby creeks. Adverse direct effects to fish habitat would occur where roads were constructed in RHCAs and particularly where roads crossed streams into which sediment would be directly routed. Sedimentation would decrease pool habitat, decrease spawning habitat, and increase direct chronic stress to salmonid populations. Any new or altered culverts and bridges at stream crossings would be designed to avoid streamflow constriction and streambed scouring. New bridges that would cross Poorman Creek and Ramsey Creek are proposed. Portions of LAD Area 2, the tailings impoundment, the Ramsey Plant Site, and the Libby Adit also would be within RHCAs or riparian areas on private land. Where roads and other mine facilities would be within RHCAs, design features and BMPs would be used to minimize additional sedimentation (MMI 2006).

Table 63. RHCAs and Other Riparian Areas within Mine Disturbance Areas.

Type of Riparian Area	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment Alternative	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative
RHCAs on National Forest System lands	253	158	206
Other riparian areas on private lands	148	9	143
Total	401	168	349

All units are acres.
RHCAs are found only on National Forest System lands.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Because of the inability to reliably quantify potential sediment increases in the Libby Creek watershed, predicting the effects on aquatic life is difficult. Increased sediment in streams would alter stream habitat by decreasing pool depth, alter substrate composition by filling in interstitial spaces used by juvenile fish and invertebrates, and increase substrate embeddedness (Rieman and McIntyre 1993; Waters 1995). These habitat alterations would adversely affect invertebrate and fish populations within the streams.

As embeddedness increases and larger substrates such as gravel and cobble are replaced by sand and silt, the available high quality habitat for many macroinvertebrate taxa decreases, often resulting in a decrease in macroinvertebrate abundance and biomass. Additionally, increased sedimentation can result in changes in the composition of the macroinvertebrate population, with more sensitive taxa, such as the EPTs, replaced by small, burrowing invertebrates such as chironomids and oligochaetes. While these taxa may be abundant, the total biomass is often

reduced, and their habitat preferences make them less available as food for fish. A reduction in macroinvertebrate abundance or changes in the composition of the macroinvertebrate population can indirectly have deleterious effects on fish populations by causing slower growth rates, higher mortality, and reduced fecundity (Berkman and Rabeni 1987; Waters 1995; USFWS 2003).

Reduced food availability is not the only mechanism through which increased sedimentation can affect fish populations. The reduced pool depths that occur with heavy sedimentation diminishes the cover and available habitat for juvenile and adult fish, particularly during periods when water temperatures are high (Waters 1995). Additionally, increased sedimentation can directly affect salmonid reproductive success by degrading and decreasing spawning and rearing habitat, and by increasing egg and juvenile mortality (Shepard *et al.* 1984; Fraley and Shepard 1989; Waters 1995; Montana Bull Trout Scientific Group 1998). Fry emergence success has been documented as decreasing substantially in westslope cutthroat trout and rainbow trout as fine sediments increased (Weaver and Fraley 1993; Bjornn *et al.* 1998). Optimal bull trout spawning and rearing areas should have less than 20 percent surface fines of 6 mm or less for the habitat to be functioning appropriately (USFWS 1998). Less than 30 percent fines (<6.35 mm) are necessary for successful bull trout incubation (Parametrix 2005). An inverse relationship between bull trout densities and the amount of fine sediment present (Watson and Hillman 1997), and between the percentage of fine sediment in the incubation habitat and survival until emergence (Weaver and Fraley 1991) have been reported.

The existing levels of fine sediment in spawning areas in analysis area streams within the Libby Creek watershed in 2005 and 2006 ranged from 14.6 to 39.4 percent fines (< 6.25 mm) (Kline Environmental Research and Watershed Consulting 2005b; Wegner, pers. comm. 2006a), with most stream reaches having levels below the 30 percent fine sediment threshold (Parametrix 2005), which begins to substantially decrease successful bull trout incubation. One upstream site on Little Cherry Creek was above this threshold, with the percent fine sediment reaching almost 40 percent, while a reach on Libby Creek upstream of the Howard Creek confluence also approached this threshold (Table 57).

The abundance of fine sediment does not currently appear to be a limiting factor to trout populations occupying most stream reaches within the Libby Creek watershed. Competition and interbreeding with brook trout and competition with other trout species is one of the larger threats to bull trout in the Libby Creek drainage. Brook trout may be more successful than native trout in degraded areas, including areas where fine sediment levels are increased (Montana Bull Trout Scientific Group 1998; Shepard 2004). Slight increases in sediment in Libby Creek may provide a competitive advantage to brook trout over bull trout. The introduction of small amounts of additional small gravels and fine sediment from construction or operation of the mine would likely have few if any effects on macroinvertebrate and fish populations, and these effects would be short-term because annual snowmelt runoff would flush most accumulated fine sediments downstream. Rieman and McIntyre (1993) advise that any increase in the proportion of fines in substrates should be considered a risk to stream productivity and bull trout populations.

The probability of catastrophic failure of the tailings or sediment ponds is low, and estimating the probability, magnitude, or long-term effects of such events are difficult. A failure modes effects analysis completed for the Little Cherry Creek impoundment estimated the risk of catastrophic failure as having a 0.1 to 1 percent chance of occurrence (Klohn Crippen 2005). If such a failure occurred, the greatest effect would occur from large masses of sediment, as well as metals in the case of tailings impoundment failure, that would enter into the stream channel and cause

substantial alterations in the habitat of analysis area streams. These alterations could in turn cause extensive adverse impacts to bull trout populations and other aquatic life. Portions of this sediment mass likely would remain within the Libby Creek channel for an undefined period following the failure, while the rest would be carried downstream out of the Libby Creek system. The amount of sediment transported into the system would depend on the volume of water associated with the failure, and the initial volume and character of the sediments. Subsequent to any such failure, normal high-volume seasonal flushing flows would continue to wash most of the remaining sediment downstream, out of the Libby Creek system, and into the Kootenai River. Consequently, most fine sediments from any such catastrophic failure would not be expected to persist within Libby Creek more than a few years. Typically, following catastrophic events and depending on season, algae populations begin natural recolonization of affected stream reaches within a few days, larger plants within a few weeks, and many aquatic invertebrates within a few months to a year. Depending on the amount of sediment deposited in the streambeds, fish populations would naturally return to former population numbers within a few years.

As part of Alternative 2, one of the possible fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. If implemented, this project would minimize the contribution of additional sediment to the Libby Creek watershed. Sediment (as percent fines) would be monitored within the Libby Creek drainage to detect any potential sediment increases. Sediment sampling would occur at a station on Libby Creek downstream of the Little Cherry Creek confluence. Sampling would occur daily during the construction phase, as most potential increases in sedimentation would be expected to occur then. During initial mine operations, sampling would occur on alternate days, and frequency would then be reduced to once per week for the remainder of the operations and reclamation phases. Based on the sampling schedule, any increases in sediment within the Libby Creek system would be detected quickly, allowing for prompt action or remediation.

Lakes

No sediment increases are projected for analysis area lakes during construction or operation of the mine. No mine activities would be located sufficiently near any of the lakes to cause sedimentation increases.

Post-Mine Operations

Streams

The potential for substantial increased sedimentation in streams after the completion of mining would be small and the effects on aquatic habitat and populations would be minimal in most analysis area streams after mine closure and reclamation. MMC would remove facility structures and reslope and revegetate disturbed areas. Revegetation practices would substantially limit erosion by providing a stabilizing cover, and interim stabilizing measures (BMPs) would be used until vegetation has been established.

The Little Cherry Creek tailings impoundment is expected to be reclaimed incrementally to minimize potential long-term erosion and maximize tailings dam stability. Surface runoff from the tailings impoundment would be directed toward Bear Creek, and would likely cause some increases in stream sedimentation during construction of the check dam and diversion channel. Stream sedimentation would have a short-term adverse effect on fish populations due to increased

sediment in the water column. An increase in fine sediment would alter substrate composition and increase substrate embeddedness, as previously discussed. These increases would be temporary, with most of the sediment flushed out of the system during high flow events, such as during snowmelt runoff or rain-on-snow events.

Lakes

No sediment increases are projected for analysis area lakes after the completion of mining. No mine activities would be located near any of the lakes.

3.6.4.2.2 Water Quantity

Mine Construction and Operations

Streams

Libby Creek. Sections 3.10.4.2.1, *Mine Area* and 3.11.4.2.1, *Effects of Inflows During Construction and Mining* provide a discussion of the predicted changes in streamflow that would occur as a result of mine and adit inflows. Mine facilities would alter flow in Libby Creek and its tributaries through mine and adit inflows, diversions, discharges, and make-up ground water wells. Make-up water wells would be necessary if mine and adit inflows were not sufficient for mill operations. Changes in flow would likely not be measurable during high flow periods between April and July. If make-up ground water wells operated along Libby Creek during the November through March, average flow in Libby Creek below Little Cherry Creek would likely be reduced by up to 6 percent, depending on the amount of mine inflows (Table 90). Percent changes in flow would be greater during lower flow periods and less in higher flow periods. The inherent difficulties in accurately measuring low flows and the natural variability in low winter flow make the determination of impacts to fish habitat very difficult, but the decrease in streamflow would decrease available salmonid habitat.

Ramsey Creek. The effect of base flow changes in Ramsey Creek would be similar to Libby Creek. Small decreases in flow in the headwater portion of Ramsey Creek may adversely affect fish habitat. Wastewater discharges at the LAD Areas would percolate to ground water, flow to Ramsey Creek, and partially offset the base flow decreases downstream of the LAD Areas while in operation.

Poorman Creek. In Alternative 2, no flow-related habitat effects resulting from mine and adit inflows are predicted to occur in the Poorman Creek drainage. Lower Poorman Creek may gain flow when the LAD Areas operate. Other potential flow increases may result due to percolation from the unlined LAD Area stormwater retention pond to Poorman Creek. Although fish habitat would probably not change from such small additions, any changes in fish habitat would be indistinguishable from natural variation in the streamflow.

Little Cherry Creek. Alternative 2 would adversely affect fish habitat in Little Cherry Creek, with the construction of the tailings impoundment and Diversion Channel. The impoundment would result in the loss of about 13,000 feet of fish habitat in the existing Little Cherry Creek, from the Diversion Dam to the mouth of the former Little Cherry Creek. A small resident redband trout population currently exists in the stream. In the lower segment of Little Cherry Creek, the stream channel transitions through a steep gradient zone consisting of bedrock outcrops, and creates an impassable barrier to migrating bull trout. Although physical barriers have prevented the migration of bull trout into Little Cherry Creek, available fish habitat is suitable for bull trout.

Alternative 2 would result in an irreversible loss of genetic diversity from the redband trout found in Little Cherry Creek if proposed efforts to collect and transfer fish from the affected segment of Little Cherry Creek to the diversion drainage were not entirely successful. Additionally, the loss of habitat in Little Cherry Creek would result in a decrease in redband populations in Little Cherry Creek with Alternatives 2 and 4. Hybridization of the pure redband trout population in Little Cherry Creek may occur in Alternative 2 if barriers did not develop in the diversion drainage as predicted and the redbands came in contact with non-native trout in the Libby Creek drainage.

Flow from the headwater reaches of Little Cherry Creek would be diverted around the tailings impoundment via a constructed diversion channel and flow into two unnamed tributaries to Libby Creek. The unnamed tributaries are intermittent streams that only flow during spring runoff and storm events. Although annual flows in these channels would increase compared to existing flows, total annual flows in both channels combined during operations would be about 60 percent of the annual flows currently at the mouth of Little Cherry Creek (see section 3.11.4.3.5, *Effects of Diversions during Construction and Mining* in section 3.11, *Surface Water Hydrology*). The agencies' analysis assumed the engineered Diversion Channel would not provide any fish habitat, while the two channels (Channels A and B) would eventually provide marginal fish habitat for either redband trout or bull trout.

Bear Creek. In Alternative 2, during operations when the Main Dam reached final crest height, the watershed of Bear Creek would be reduced by 8 acres because runoff from the dam would be collected by a diversion ditch at the toe of the Main Dam (see section 3.11.4, *Environmental Consequences*). The change in streamflow would be immeasurable and would not affect aquatic habitat.

East Fork Rock Creek. The agencies' numerical model predicts that the base flow of East Fork Rock Creek would be reduced due to mine and adit inflows. These flow changes would affect the aquatic habitat in the high gradient reach of East Fork Rock Creek between Rock Lake and Rock Creek Meadows, a distance of about 0.75 mile. Trout habitat may be reduced during low flows from August to April. This habitat loss would be detrimental to the resident westslope cutthroat trout populations in the higher elevations of East Fork Rock Creek. Changes in flow downstream from Rock Creek Meadows would not likely be measurable, but would contribute to the dewatered sections of lower Rock Creek.

East Fork Bull River. In Alternative 2, similar to East Fork Rock Creek, the agencies' numerical model predicts that the base flow of East Fork Bull River would be reduced due to mine and adit inflows. These flow changes would affect aquatic habitat in the river, which begins about 1.3 miles into the CMW. Changes in flow in the East Fork Bull River below St. Paul Lake due to mine operations may be difficult to separate from the natural variability of low streamflows. Decreased base flow in the upper river may result in habitat loss and adversely affect the adfluvial bull trout population that spawns in this stream.

Lakes

Rock Lake. Because deep bedrock ground water is a contributor to Rock Lake throughout the year, mining may affect the level of Rock Lake. The agencies' ground water model predicts a decrease in ground water inflow to Rock Lake. This may result in measurable changes in lake level during periods when deep ground water provides the only source of water to the lake (*i.e.*, when there is no snowpack above the lake and no precipitation in the watershed above the lake).

Reduced water levels in Rock Lake may decrease available habitat for cutthroat trout present in Rock Lake.

St. Paul Lake. St. Paul Lake has widely fluctuating water levels and is maintained through stocking of westslope cutthroat trout every 3 years. Any effect on aquatic life from changes in base flow would be minimal.

Post-mine Operation

Streams

Libby Creek. Post-mining, it is predicted that a slight increase in streamflow would occur in upper Libby Creek, while a slight decrease in streamflow would occur beyond Libby Adit to the confluence of Bear Creek. A slight decrease in streamflow in Libby Creek may decrease available habitat during low flow periods, adversely affecting salmonids in the stream. During the post-mining period, tailings water would continue to be discharged at the LAD Areas. Discharges at the LAD Areas would percolate to ground water and flow into area streams, increasing Libby Creek streamflows. This additional flow in Libby Creek below the LAD Areas would partially offset reduced base flow in lower Libby Creek. Aquatic habitat would not be affected while discharges continue.

Ramsey Creek. Base flows are predicted to increase slightly in Ramsey Creek post-mining, but the flow increases are likely to be immeasurable. Like Libby Creek, the lower elevation reach of Ramsey Creek would continue to receive additional flows via percolation from the LAD Areas. The base flow increases would benefit fish habitat in Ramsey Creek.

Poorman Creek. The lower elevation reaches of Poorman Creek could continue to receive additional flows via percolation from the LAD Areas while the seepage collection system is operating. The flow increases would benefit fish habitat. After wastewater discharges at the LAD Areas cease, aquatic habitat in Poorman Creek would return to pre-mine conditions.

Little Cherry Creek. The tailings impoundment and Diversion Channel on Little Cherry Creek would remain in place. Flow in the diverted Little Cherry Creek channel would be about one-half the flow in the original channel. Only marginal fisheries habitat would be available for potentially viable fish populations. Seepage would continue to occur from the tailings impoundment, which would be captured and recycled to the impoundment or discharged at the LAD Areas until water quality standards were met.

The watershed area of the former (original) Little Cherry Creek channel would be about one-fourth of the original watershed area. Streamflow would consist of runoff from the impoundment dam face and the remaining watershed area below the Seepage Collection Dam. Any surface water flow below the tailings impoundment entering the former lower Little Cherry Creek channel would not support a viable fish population. Runoff from the impoundment surface would be directed toward Bear Creek.

Bear Creek. Post-mining, runoff from the tailings impoundment would be directed toward Bear Creek via a riprapped channel. A small rockfill check dam would be located just beyond the northwest end of the reclaimed impoundment. The check dam would be designed for the 100-year flood event. Short-term erosion in the ditch and subsequent sedimentation in Bear Creek would occur during construction of the ditch and check dam. This would result in short-term loss of food resources (such as macroinvertebrate drift with sedimentation and covering of substrate) and

short-term chronic effects to the fish (such as avoidance and reduced feeding). Where runoff flows into Bear Creek, the Bear Creek watershed area would increase by an estimated 8 percent (Appendix H). The projected increase in average annual flow of 4 to 5 percent would benefit fish habitat in Bear Creek. The larger watershed would increase runoff during stormwater runoff and would not affect base flows.

East Fork Rock Creek. Post-mining, the agencies' numerical model predicts that base flow in East Fork Rock Creek would continue to be slightly less than pre-mining flow conditions. The predicted flow changes would be within the range of natural variability for this stream and would not affect fish or fish habitat.

East Fork Bull River. Base flows during the post-mining period are predicted to increase slightly compared to pre-mining conditions in the East Fork Bull River drainage. Additional flows would benefit fish habitat, although any base flow-related habitat changes would be difficult to separate from natural variability.

Lakes

Rock Lake. Post-mining, after the mine void became filled with ground water, base flow into Rock Lake is predicted by the agencies' numerical model to be less than pre-mining conditions, but more than during operations. It is predicted that it would take up to 70 years for the ground water level to return to pre-mining conditions. Aquatic habitat changes would be difficult to separate from those caused by natural variability in lake levels.

St. Paul Lake. Post-mining, after ground water levels return to pre-mining conditions (up to 70 years), the numerical model predicted that ground water from the filled mine void may flow toward the East Fork Bull River drainage. St. Paul Lake may have slightly higher water levels than pre-mine and mining conditions, but base flow-related habitat changes would be difficult to separate from those caused by natural variability in lake levels.

3.6.4.2.3 Water Quality-Nutrients

Only minor differences in nutrient concentrations are expected during the three phases of mining operations; therefore, predicted impacts are discussed collectively rather than divided into construction, operation, and post-operation phases. Additionally, no changes in nutrient concentrations within the Rock Creek and East Fork Bull River drainages are predicted to occur with any of the alternatives, as surface disturbance near these streams is limited to the construction of the Rock Lake Ventilation Adit. These streams are not discussed further with regard to effects of changing nutrient concentrations.

Construction, Operation, and Post-Operation of Mine

Streams

The surface waters of the Libby Creek drainage have extremely low concentrations for most dissolved nutrients (Table 96 and Table 97). The low nutrient concentrations contribute to limited aquatic productivity. Mass balance calculations estimate a substantial increase over background nitrogen (nitrate and ammonia) concentrations in Ramsey, Poorman, and Libby creeks from the LAD Areas during periods of low flow (Table 101). These calculations assume no treatment in addition to land application.

If the TIN concentration in Libby Creek surface water increased to the nondegradation limit of 1 mg/L set in the BHES Order, the ER for TIN concentrations would be 6.7 to 10 in Ramsey, Poorman, and Libby creeks (Table 64). The TIN concentration would be relatively low. A TIN concentration of 1 mg/L may cause an increase in algal growth in Libby Creek, but algal growth would more likely be limited by factors other than nitrogen (*i.e.*, phosphorus, temperature, and light). Increased algal growth would stimulate productivity rates for aquatic insects and, consequently, stimulate populations of trout and other fish populations. Although the projected TIN concentration would be greater than existing conditions, the ammonia component of TIN would remain well below the applicable ammonia ALS (Table 64), indicating no potential toxicity from increased ammonia concentrations.

Table 64. Projected Changes in Total Inorganic Nitrogen, Alternative 2.

Condition	Units	RA-600	PM-1000	LB-1000
Ammonia Chronic ALS[†]	mg/L	6.44	6.29	5.67
Ecoregion Reference TIN[‡]	mg/L	0.2	0.2	0.2
Existing Surface Water Conditions[§]				
pH	s.u.	6.7	6.8	7.1
Ammonia	mg/L	<0.05	<0.10	<0.05
Nitrate	mg/L	<0.06	0.05	0.05
Estimated TIN	mg/L	<0.11	<0.15	<0.10
Potential TIN	mg/L	1	1	1
Enrichment Ratio		9.1	6.7	10

mg/L = milligram per liter; s.u. = standard units.
Projected changes assume TIN increases up to the BHES Order nondegradation limit of 1.0 mg/L.
[†]Ammonia chronic ALS value is pH and temperature dependent. Temperature was assumed to be 0°C.
[‡]25th percentile of reported total nitrogen for nutrient ecoregion II, level III subecoregion 15 (Environmental Protection Agency 2000).
[§]Median concentrations in analysis area streams are presented in Table 96 and Table 97.

Lakes

The contribution of regional ground water to Rock and St. Paul lakes may be reduced as a result of mining, resulting in the lake becoming more concentrated, with higher dissolved mineral concentrations. Estimated nutrient concentrations in ground water during construction, operations, and post-operation of the mine are expected to be low. As a result, lake nutrient concentrations are likely to stay very low; therefore, no effects to aquatic life are anticipated.

3.6.4.2.4 Water Quality-Metals

Only minor differences in effects from metals concentrations would be expected during the three phases of operation; therefore, predicted impacts are discussed collectively rather than divided into construction, operation, and post-operation phases. The only exception may be the East Fork Bull River. About 70 years post-mining, water levels overlying the mine void would reach steady state conditions. The agencies' numerical model predicts that ground water in the mine void has the potential to flow toward the East Fork Bull River drainage. The predicted concentrations of metals in the mine void ground water would be relatively low. Should ground water flow from the filled mine void about 3,000 feet vertically through fractures to the East Fork Bull River,

attenuation of the dissolved metals and dilution would likely reduce metal concentrations. The fate and transport of dissolved metals within the flooded mine void cannot be predicted with certainty, particularly when compared to the relatively low surface water standards. Therefore, effects on aquatic biota cannot be estimated with any degree of certainty.

Additionally, no changes in metals concentrations within the Rock Creek drainage are predicted to occur with any of the alternatives because surface disturbance near this stream would be limited to the construction of the Rock Lake Ventilation Adit. This stream is not discussed further with regard to effects of changing metals concentrations.

Construction, Operation, and Post-Operation of Mine

Streams

Table 101 provides the projected concentrations of various parameters for streams affected by discharges of wastewater. Concentrations of manganese are projected to increase above existing conditions during post-mining operations. As discussed previously, increased manganese concentrations are not expected to affect aquatic life. Concentrations of other metals are not projected to increase.

The BHES Order would allow total copper concentrations up to 0.003 mg/L in all surface waters affected by the project (BHES 1992). About half the surface water samples from Libby Creek had copper concentrations below the detection limit, 15 percent were greater than 0.003 mg/L, and the remaining samples were 0.003 mg/L or less (Table 65). The ER for copper may increase up to a factor of 3 or more, depending on the actual concentration of copper in samples below detection limit values, and the actual instream copper concentration after discharge of wastewater. Potential effects to aquatic life from an increase in copper concentrations are difficult to determine given recent uncertainties regarding the protectiveness of the hardness-modified copper standard and existing instream copper concentrations. Since the 1996 release of hardness-modified copper criteria recommendations (EPA 1996), additional research has shown that water quality parameters other than hardness and ionic composition affect copper toxicity. In 2007, the EPA released new water quality recommendations for copper toxicity using the biotic ligand model (BLM). The BLM uses multiple water quality parameters when determining the appropriate copper standard (EPA 2007). The detailed water chemistry data needed for BLM predictions are not available for the Libby Creek watershed. Preliminary analysis with the BLM indicates dissolved organic carbon and pH can be the primary drivers that influence copper toxicity (HydroQual, Inc. 2008). Typical ground water and snowmelt-fed mountain streams would be expected to have low dissolved organic carbon concentrations that make dissolved copper bioavailable and potentially toxic. Predicted increased nitrogen concentrations may increase primary productivity and likely increase dissolved organic carbon concentrations, which may offset potential toxic responses due to increased copper concentrations. Furthermore, measured instream copper concentrations are either at or near minimum laboratory detection limits, creating some uncertainty with any change in concentration from existing conditions.

The low concentrations of dissolved minerals in surface waters of the Libby Creek drainage cause these waters to tend toward acidic pH levels, and to have extreme sensitivities to fluctuations in acidity. For most heavy metals, the percentage of the metal occurring in the dissolved form increases with increasing acidity. Generally, dissolved metals are the most bioavailable fraction and have the greatest potential toxicities and effects on fish and other aquatic organisms. Any increase in metal concentrations could increase the potential risk for future impacts to fish and

other aquatic life in some reaches. Metal concentrations near the ALS could result in physiological stress, such as respiratory and ion-regulatory stress, and mortality. Specifically, effects of zinc concentrations at the BHES Order limit may cause decreased growth rates in aquatic insects and avoidance in salmonids (Eisler 2000). These zinc concentrations combined with the low percentage of samples above ALS (Table 65) would not substantially affect the aquatic biota.

Table 65. Summary of Copper and Zinc Concentrations in Surface Water Samples from Libby Creek.

Metal	Chronic ALS	Number of Samples	Number of Samples Below Detection Limit	Number of Samples greater than Chronic ALS	Number of Samples with Detections less than Chronic ALS
Copper	0.00285	229	109	32	88
Zinc	0.037	229	173	19	37

ALS = Aquatic life standard.
Source: Analysis by ERO Resources Corp. using data from Geomatrix 2007f.

Predicting potential impacts to fish and other aquatic life in the Libby Creek watershed is significantly complicated by the fact that the very low hardness and total alkalinity occurring in these waters naturally cause potential ion-regulatory difficulties and stress in fish. These problems are exacerbated by the low nutrient and productivity levels in the streams that permit only minimal production of food organisms for fish, causing additional stress to fish and other aquatic life.

Catastrophic failure of the tailings impoundment would release tailings with elevated metal concentrations into the diverted Little Cherry Creek and Libby Creek. The effects were discussed in section 3.6.4.2.1, *Sediment.*

Lakes

As a result of mining, Rock and St. Paul lakes may have higher dissolved mineral concentrations, which may decrease algal and macroinvertebrate production in both lakes, and potentially reduce the fishery of Rock Lake.

3.6.4.2.5 Toxic Metals in Fish

Any increased metal concentrations in surface water would increase metal concentrations in fish. MMC has committed to treating water prior to discharge, if necessary, to meet water quality standards or BHES Order limits. With LAD or other treatment, the risk of increased metal concentrations in fish would be low. The flow in former lower Little Cherry Creek would not be sufficient to support fish. No changes in metal concentrations within the Rock Creek drainage are predicted with any of the alternatives because surface disturbance near this streams is limited to the construction of the Rock Lake Ventilation Adit.

3.6.4.2.6 Fish Passage and Fish Loss

Construction and Operation of Mine

Streams

Proposed road reconstruction between U.S. 2 and the Ramsey Plant Site would include stream crossing upgrades on Little Cherry, Ramsey, and Poorman creeks. Bridge construction to meet INFS standards, along with implementation of MMC's proposed BMPs, would minimize effects to fish passage. Based on these measures, no additional barriers to fish passage from stream crossings would be created in Alternative 2.

No additional stream crossings are proposed in the Rock Creek and East Fork Bull River drainages; therefore, no effects to fish passage from road or bridge construction would be expected to occur. Decreased base flows predicted to occur in the upper Rock Creek and East Fork Bull River drainages, mainly during operation of the mine, may reduce available bull trout and westslope cutthroat trout habitat and fish passage. The reduction in habitat may affect bull trout more severely than westslope cutthroat trout because they spawn during low flow times of the year from August through November. Additionally, dewatered reaches of Rock Creek have been observed during low flow time periods under existing conditions, and these reaches might remain dewatered for longer time periods and/or the length of stream dewatered may increase. Because these reaches are near the mouth of Rock Creek, they may further reduce migratory bull trout from accessing any significant portion of the Rock Creek drainage for spawning. The bull trout population in Rock Creek is thought to be composed primarily of resident fish, but migrant bull trout also have been observed. To some extent, the dewatered reaches may be protecting the resident bull trout population in Rock Creek from hybridization or competition with non-native fish by limiting non-native fish access to Rock Creek from the lower Clark Fork River.

The Little Cherry Creek diversion is not predicted to alter fish passage because Little Cherry Creek currently has a series of permanent barriers thought to prevent upstream fish passage under all flow conditions. These barriers limit access to Little Cherry Creek from fish in Libby Creek to the most downstream 950 feet of Little Cherry Creek (Kline Environmental Research 2005b). Downstream fish passage would be unrestricted by the diversion, but the amount of habitat available for the redband trout that inhabit the diverted Little Cherry Creek would decrease. The diversion drainage is proposed to be a permanent structure. Effects on the redband trout population in Little Cherry Creek would be minimal, but would persist long term.

No direct unmitigated losses of fish are predicted from construction or operation of the proposed project. To mitigate the fisheries impacts associated with the Little Cherry Creek diversion and the riprapped tailings impoundment overflow channel to Bear Creek, MMC would implement a Fisheries Mitigation Plan. Before any other mitigation work was attempted, and immediately before closure of the Little Cherry Creek Diversion Dam, MMC would collect all fish in the existing stream section and move the fish to the newly constructed diversion channel. MMC would design the Little Cherry Creek Diversion Channel, to the extent practicable, for fish habitat and passage. MMC's survey of the unnamed tributary to Libby Creek that would receive diverted water indicates that most of the drainage would develop habitat comparable to Little Cherry Creek. MMC would mitigate losses should the Little Cherry Creek Diversion not fully support fish populations formerly associated with Little Cherry Creek. Other fisheries enhancement projects would be implemented to mitigate fisheries losses. While MMC would remove redband trout safely from the section of Little Cherry Creek to be diverted and then place them in the new diversion drainage, some fish mortality due to handling stress may occur during removal, storage,

or replacement. Additionally, the loss of habitat in Little Cherry Creek could cause an indirect loss of trout if the available habitat in the remaining portion of Little Cherry Creek and the diversion drainage did not support the population at its current numbers.

Lakes

Low flow in East Fork Rock Creek and East Fork Bull River would provide a barrier to fish moving out of or into Rock Lake and St. Paul Lake during base flow periods. No surface outlet exists at St. Paul Lake; therefore, no effects to fish passage would occur. Westslope cutthroat hybrids exist in Rock Lake. If trout were prevented from moving out of the lake, the westslope cutthroat trout population in East Fork Rock Creek may benefit because some pure westslope cutthroat trout are present in this stream, and the barrier would protect them from hybridization with trout from Rock Lake. Barriers to upstream fish passage into Rock Lake are already present and would not be affected by mine activities.

Post-mine Operation

Streams

Negligible effects on aquatic populations would occur due to stream crossings once the mine was closed and reclamation completed. Predicted decreased fish habitat and possible flow barriers in the Rock Creek drainage from reduced base flow are expected to continue to a lesser extent during the post-operational period. No additional direct unmitigated losses of fish are expected during the post-operation period.

Lakes

The periods of low flow in East Fork Rock Creek are predicted to continue to a lesser extent during post-mine operations. Barriers that prevent fish movement into and out of these lakes may persist. As discussed previously, while these limitations decrease available trout habitat in both streams, they may help reduce hybridization of the westslope cutthroat trout population in East Fork Rock Creek.

3.6.4.2.7 Threatened and Endangered Species

Construction and Operation of Mine

Streams

Alternative 2 may affect bull trout and their habitat in analysis area streams. As discussed in previous sections, some short-term and, possibly, long-term impacts may result from increases in the amount of fine sediment. Bull trout populations in Libby Creek and the rest of the tributaries would not be directly affected by the loss of habitat in Little Cherry Creek because they do not have access to that habitat as a result of barriers to fish passage near the mouth. Changes in flow within the Libby Creek drainage are expected to be minimal and would not impact the bull trout populations within the drainage. Vegetation clearing and other disturbances are proposed within RHCAs. If riparian shading decreased significantly, increases in stream temperatures would result and would potentially adversely affect bull trout populations. Bull trout require water temperature ranging from 2°C to 15°C, with temperatures at the low end of this range required for successful incubation (USFWS 1998). While sufficient canopy cover data to adequately address this issue are lacking, the removal of additional riparian canopy may increase water temperatures.

Under Alternative 2, bull trout populations in the Libby Creek watershed would continue to be marginal and their habitat in need of restoration work from existing, non-project impacts. Bull

trout populations would continue to be susceptible to decline or disappearance due to hybridization with introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances. Based on limited survey data, brook trout abundances appear to be increasing within the Libby Creek drainage, and habitat degradation generally favors brook trout when competing with bull trout (Rieman and McIntyre 1993). The effect of any habitat change from mine activities in Alternative 2 may indirectly be magnified by giving brook trout an additional competitive advantage. The small resident bull trout population upstream of Libby Creek Falls would be protected from the threat of hybridization or competition with brook trout because the falls prevent access to this segment of Libby Creek from fish downstream.

Bull trout populations in the Rock Creek and East Fork Bull River drainage would be adversely affected by mine activities in Alternative 2. Changes in streamflow may limit bull trout habitat, and may create barriers by reducing base flow within these drainages. Because bull trout spawn from August through November when base flow conditions often occur, available spawning habitat in these streams may decrease. Additionally, bull trout prefer to spawn in areas with ground water discharge because these areas tend to remain open throughout winter, maintain appropriate incubation temperatures, and increase the water exchange rate (Montana Bull Trout Scientific Group 1998). About 0.75 mile below Rock Lake, East Fork Rock Creek enters a flat area with a considerable thickness of alluvium (Rock Creek Meadows). Water storage in the alluvium is likely sufficient to mask any potential decreased base flow at this location and downstream. Predicted changes in base flow above Rock Creek Meadows would likely be measurable, but changes at or downstream of Rock Creek Meadows would not likely be measurable.

Like Rock Creek, if the thickness of the alluvium along East Fork Bull River increased downstream of St. Paul Lake, water storage in the alluvium may be sufficient to mask any potential decreased base flow. Because the East Fork Bull River is considered the most important bull trout stream in the lower Clark Fork River drainage (Montana Bull Trout Scientific Group 1996), decreased levels of bull trout spawning within this stream could have long-term adverse effects on the bull trout population within the lower Clark Fork River drainage.

Components of MMC's Fisheries Mitigation Plan would benefit bull trout populations in the Libby Creek watershed. The mitigation plan includes the genetic analyses of bull trout to determine if any hybridization with brook trout is occurring within the drainage, and one or more habitat restoration projects in Libby Creek and its tributaries. The proposed restoration projects are aimed at creating high quality habitat necessary to sustain wild trout populations.

Components of MMC's fisheries mitigation specifically related to the Libby Creek watershed include: 1) conduct fish investigations to determine the genetics, distribution, and abundance of fishes of concern; 2) rehabilitate habitat upstream from the mouth of Howard Creek through creation of pool and hiding cover habitat, stabilization of old mining spoils, and channel narrowing; enhance habitat values in stream reach immediately downstream of the Libby Adit Site; 3) conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks.

Lakes

Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Post-mine Operations

Upon mine closure, mine facility sites and roads would be reclaimed, and effects of mining activities on bull trout populations in the Libby Creek watershed are expected to be minimal. Unrelated to mine activities, hybridization with brook trout would continue to threaten the bull trout populations in the Libby Creek, Rock Creek, and East Fork Bull River watersheds. Additionally, there could be post-mining changes in analysis area streamflows (described in sections 3.10.4.2.1, *Mine Area* and 3.11.4.2.1, *Effects of Inflows During Construction and Mining*). The flow changes may likely be within the range of natural variability for the stream. Predicted flow increases in some streams would provide additional flow during spawning season. Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Surface runoff from the Little Cherry Creek tailings impoundment would be directed toward Bear Creek, and would likely cause some increases in stream sedimentation during construction of a check dam and diversion channel. Increased stream sedimentation would have a short-term adverse effect on the bull trout population in Bear Creek due to increased sediment in the water column and the substrate. These increases would be temporary, with most of the sediment flushed out of the system during high flow events, such as during snowmelt runoff or rain-on-snow event.

Effects to Critical Habitat

The USFWS has designated critical habitat in streams in the analysis area: Rock Creek, East Fork Rock Creek, Libby Creek, Poorman Creek, Ramsey Creek, and West Fisher Creek (Figure 56). Alternative 2 would affect bull trout in both the Clark Fork River and Kootenai River drainages. None of the mine alternatives, including Alternative 2, would affect designated critical habitat in West Fisher Creek. Effects on designated critical habitat in West Fisher Creek are discussed in section 3.6.4.9.3, *Threatened, Endangered, or Sensitive Species* for the transmission line Alternative E.

No roads or other facilities are proposed in any designated segment in Alternative 2. Alternative 2 would affect two segments of designated critical habitat in Libby Creek, one downstream of Howard Creek and one downstream of Little Cherry Creek. The short segments on Ramsey and Poorman creeks also would be adversely affected. Facility construction would occur upstream of the four segments, which would increase sedimentation in these four designated segments. Increased nutrient and metal concentrations also would affect these four segments.

Alternative 2 may affect the four segments of critical habitat in East Fork Rock Creek and Rock Creek and the segments in Libby Creek. Changes in streamflow may limit bull trout habitat, and may create barriers by reducing base flow within these drainages. Because bull trout spawn from August through November when base flow conditions often occur, available spawning habitat in these streams may decrease. During operations and post-operations, diversion from the Little Cherry Creek drainage would reduce average annual flows by 2 to 3 percent in critical habitat between Little Cherry Creek and Bear Creek.

3.6.4.2.8 Sensitive Species

Construction and Operation of Mine

Streams

Alternative 2 may impact redband trout. Redband trout inhabit the Libby Creek drainage within the analysis area. Abundance may decrease as a result of possible increases in sediment in Alternative 2. Additionally, the diversion of Little Cherry Creek to accommodate placement of the tailings impoundment would result in a loss of 13,000 feet of redband trout habitat. Because barriers to fish passage exist near the confluence of Little Cherry Creek and Libby Creek, this loss of habitat would not affect the hybrid redband trout populations in Libby Creek and the remaining tributaries within the analysis area. The purity of the redband trout population within Little Cherry Creek has likely persisted due to the location of these barriers, which effectively block the entry of rainbow trout and hybrid trout from Libby Creek into Little Cherry Creek. If the diversion drainage developed similar barriers to upstream passage of fish from Libby Creek, as is expected (Kline Environmental Research 2005a), the pure redband population would persist. If such barriers did not develop, the population would be at risk of hybridization.

MMC's proposed mitigation in Alternative 2 includes the removal of all trout inhabiting Little Cherry Creek and their subsequent transfer to the diversion drainage. These efforts would minimize any immediate loss of trout resulting from the proposed alterations to Little Cherry Creek. Average flow in the diverted Little Cherry Creek would be about 60 percent of the original Little Cherry Creek during operations and 55 percent post-operations. The loss of available habitat in the diverted Little Cherry Creek would adversely affect the redband trout population in the diverted creek because the remaining habitat would probably not support the population at its current numbers.

Alternative 2 may impact westslope cutthroat trout. A pure westslope cutthroat trout population is present in East Fork Bull River and pure and hybrid westslope cutthroat trout exist in the Rock Creek drainage. These trout are present in relatively high densities, particularly in the East Fork Bull River. As with bull trout, reduced base flows in the upstream reaches of these streams during certain times of the year would decrease the amount of available habitat to westslope cutthroat trout populations. While these effects may adversely impact the westslope cutthroat populations in these streams, the higher numbers of westslope cutthroat trout indicate that the populations are at less risk than the bull trout populations. The main risk to westslope cutthroat populations would likely continue to be hybridization and competition with non-native trout.

Lakes

Pure populations of redband or westslope cutthroat trout do not inhabit any analysis area lakes; thus, the hydrological effects to these lakes would not directly affect redband or westslope cutthroat trout populations.

Post-mine Operations

Post-mining, mine facility sites and roads would be reclaimed, and effects of mining activities on the hybrid redband trout populations in the Libby Creek watershed would be minimal. The diversion drainage is expected to be a permanent structure, and the reduction in stream habitat in the diverted Little Cherry Creek may continue to adversely affect the pure redband trout that would be moved to the channel.

The westslope cutthroat trout populations in Rock Creek would continue to be affected by decreased flows in the stream, although to a lesser extent. The decreased flows are predicted to persist in these streams after mine operations ceased. Hybridization would continue to be the primary threat to the westslope cutthroat trout populations in these watersheds.

Pure populations of redband or westslope cutthroat trout do not inhabit any of the analysis area lakes; thus, the hydrological effects to analysis area lakes would not directly affect these trout populations.

3.6.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate the agencies' proposed modifications and mitigating measures that would reduce or eliminate impacts to area streams. Four major mine facilities would be located in alternative locations. The most major change from Alternative 2 would be locating the tailings impoundment at the Poorman Impoundment Site, eliminating the need for a diversion around Little Cherry Creek. Additionally, the plant site would be located between Libby and Ramsey creeks, two additional adits would be constructed in the upper Libby Creek drainage eliminating most construction in the Ramsey Creek watershed, and the disturbance areas for the LAD Areas would be modified to avoid affecting RHCAs.

3.6.4.3.1 Sediment

Construction and Operation of Mine

Streams

As with Alternative 2, only the Libby Creek watershed would be at risk from impacts from increased sediment. In general, potential sediment impacts would be reduced in Alternative 3 compared to Alternative 2. Because of the difficulties in quantifying any sediment increases and their effects on aquatic life for either alternative, the extent of the decrease is not known. The locations and structures of the plant site, LAD Area, and impoundment site in Alternative 3 would result in a decreased number of disturbed acres within RHCAs. Alternative 3 would affect 158 acres of RHCAs on National Forest System lands and 9 acres of other riparian areas on private land, substantially less than Alternative 2 (Table 63). RHCAs are shown on Figure 54. Because RHCAs are designed to act as a buffer to protect the streams from sediment as well as other impacts, fewer disturbances within these areas would reduce the amount of sediment that would reach the streams, particularly during the construction phase when sediment impacts have the greatest probability of occurring.

Additional measures would be taken in Alternative 3 to reduce the risk of sediment increases in analysis area streams. The Wildlife Mitigation Plan in Alternative 3 (section 2.5.7.3, *Wildlife Mitigation*) includes 20.3 miles of proposed access changes that would be implemented before MMC would proceed with the Libby Adit evaluation program. Up to 20.1 miles of other proposed access changes would be implemented before any other construction. MMC would build and maintain gates or barriers on the roads, and complete other activities so the roads would either be removed from service, or cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. In most cases, culverts would be removed; such removals would occur in active stream channels requiring instream work, structure placement, and fill removal. In the short term, these activities would increase sedimentation in area streams. After the activities were completed, and the roads became stabilized, habitat in area streams would improve. The Fisheries Mitigation Plan (section 2.5.7.2,

Fisheries Mitigation) in Alternative 3 includes implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources in the Libby Creek watershed.

The access changes also would allow the re-establishment of RHCAs along these roads, estimated to be 27 acres in the Libby Creek watershed, 10 acres in the East Fork Rock Creek watershed, and 4 acres in the Fisher River watershed. The Fisheries Mitigation Plan in Alternative 3 includes an inventory of existing sediment sources in Libby Creek and the implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from identified sources.

Because the tailings impoundment in Alternative 3 would not require diversion of a perennial stream and would be located within a smaller watershed, the amount of disturbance and subsequent erosion potential within that area is expected to be less than in Alternative 2. Interim reclamation would occur at the tailings facility, which would result in minimizing sediment in surface water runoff as unreclaimed areas would be limited to active disposal areas. Furthermore, localized sediment retention structures and BMPs for sediment and storm water runoff control would be used. Diversion ditches would be designed to accommodate a 10-year/24-hour storm event and overflows would occur rarely.

Additional measures would be taken in Alternative 3 to incrementally stabilize soil stockpiles and begin revegetation of these stockpiles immediately to reduce erosion. MMC would incrementally stabilize soil stockpiles in Alternative 3 rather than waiting until capacity was reached. Furthermore, replacement of soils in the impoundment area would be based on their erodibility and slope steepness to minimize erosion potential. All permanent cut and fill slopes on roads would be seeded, fertilized, and stabilized.

Based on these measures and the overall decreased amount of disturbed areas within RHCAs, impacts to aquatic life from increased sediment are expected to be substantially reduced compared to Alternative 2. Effects from increased sedimentation in Little Cherry Creek, Poorman Creek, and Ramsey Creek due to mine facilities would be minimal, except potentially in storm events larger than the 10-year/24-hour flood. As discussed previously, even when larger storms occur, the high water volumes would likely flush much of the sediment out of the system. Some sediment increases would likely occur during road construction, but these also would be minimized by adhering to INFS standards and guidelines as well as BMPs. Construction and to a lesser extent operation of the Libby Plant Site Creek would result in small increases in sediment to Libby Creek.

If large storm events occurred and/or erosion control structures failed, increased sediment would enter analysis area streams. With Alternatives 3's mitigation measures, the likelihood of this occurring would less than in Alternative 2. As in Alternative 2, if substantial releases of sediment occurred despite these measures, substantial adverse short-term and/or long-term impacts would be possible to aquatic life.

The probability of catastrophic failure of the tailings impoundment or sediment ponds is low. If a failure were to occur, large masses of sediment (and metals in the case of tailings impoundment failure) could enter analysis area streams and cause substantial alterations in habitat. These alterations would, in turn, cause extensive adverse effects to bull trout populations and other aquatic life. Because the tailings would be thicker than the slurry tailings in Alternative 2, less of

the higher density tailings would be expected to be delivered to nearby streams. If the thicker tailings reached adjacent streams, the higher density of the tailings would make flushing of the system less effective and could slow recovery of the aquatic populations.

The construction of the two additional adits in the Libby Creek drainage would cause minimal increase in sediments in that reach of Libby Creek because the disturbance area associated with the additional adits would be generally small.

Lakes

Sediment would not increase in the analysis area lakes during construction or operation of the mine because no surface mining activities would be located near any of the lakes.

Post-mine Operations

Streams

Once the mine closed, the risk of increased sediment to streams within most of the analysis area would be low. Surface runoff from the Poorman tailings impoundment would be directed toward Little Cherry Creek, and would likely cause some increases in stream sedimentation during initial closure. Increased stream sedimentation would have a short-term adverse effect on fish populations in Little Cherry Creek due to increased sediment in the water column and the substrate. These increases would be temporary, with most of the sediment flushed out of the system during high flow events, such as during snowmelt runoff or rain-on-snow event. Bear Creek would not be affected by Alternative 3.

Alternative 3 includes plans for concurrent and interim reclamation of inactive portions of the tailings impoundment, pipeline corridor, and soil stockpiles. By the time the mine closed, reclamation would have already begun in some disturbed areas. Once vegetation established in these areas, sediment transport in surface runoff would decline. All short- and long-term reclamation objectives in Alternative 2 are retained in Alternative 3, and all of the erosion and sediment control measures described in Alternative 2 also would be implemented. The increased watershed area of Little Cherry Creek would result in an average increase in annual flow, which would increase the sediment load to Little Cherry Creek. Initial sediment loads would have an adverse effect on the aquatic biota, but sediment loads would decrease and the channel would readjust to provide higher quality aquatic habitat than is currently available.

All currently gated or barricaded roads used in Alternative 3 would be decommissioned by using a variety of treatment methods to achieve desired conditions for other resources. Constructed roads would be water-barred and recontoured to prevent increased sedimentation into streams. The existing bridges across Poorman Creek on the Bear Creek Road (NFS road #278) and the Little Cherry Loop Road (NFS road #6212) would be removed at closure and the road revegetated. These measures would result in some short-term increase in sedimentation (*e.g.*, bridge removal), but the long-term effect would be a reduction in sediment input to the streams and no adverse effects to the aquatic biota.

Lakes

No sediment increases are projected for St. Paul Lake or Rock Lake during post-mine operation activities in Alternative 3.

3.6.4.3.2 Water Quantity

Construction and Operation of Mine

The primary difference between Alternative 2 and Alternative 3 would be the location of the tailings impoundment between Poorman and Little Cherry creeks. There would be no direct loss of fish habitat in Little Cherry Creek. The watershed contributing to streamflow in Little Cherry Creek would increase by 5 to 8 percent, resulting in a slight increase in available habitat. Any benefits to the fishery would be marginal.

In high elevation stream reaches and lakes, base flow habitat effects resulting from ground water drawdown would be similar for all mine alternatives. Changes in base flows would probably not affect Ramsey Creek because all adits, except the Rock Lake Ventilation Adit, would be in the Libby Creek drainage. Three adits in the Libby Creek drainage may reduce the base flow in Libby Creek more than Alternative 2, but the changes to the aquatic habitat would be small and would have no effect to aquatic life in Libby Creek. No flow-related habitat effects resulting from ground water drawdown are expected to occur in the Little Cherry Creek drainage.

Flow would decrease in Libby Creek by about 4 percent during November through March if make-up water withdrawals occur during those months. Alternative 3 would include the installation of grade control structures in a reach of Libby Creek between Little Cherry Creek and Bear Creek to decrease the width to depth ratio and increase the frequency of deep pool habitat. Grade control structures would improve bedload transport and reduce fine sediment accumulation. Structures would be monitored and maintained for the life of the mine. Population monitoring would be conducted for the life of the mine to determine effectiveness of the structures. Annual monitoring reports describing monitoring results and overall mitigation effectiveness would be submitted to the agencies. The proposed mitigation would minimize the effect of winter-time flow reduction on aquatic habitat.

Post-mine Operations

Except for effects on Little Cherry Creek, Alternative 3 post-mining effects would be similar to Alternative 2 (section 3.6.4.2.2, *Water Quantity*). If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Flow in Bear Creek would not be affected. Surface water runoff from the tailings impoundment would be routed to an unnamed tributary of Little Cherry Creek. Average annual flow in Little Cherry Creek would increase because the watershed contributing flow to Little Cherry Creek would increase by 44 percent. The larger watershed would increase runoff during stormwater runoff and would not affect base flows. Flow in Libby Creek between Poorman Creek and Little Cherry Creek would decrease very slightly. The reduction in flow in Libby Creek would not be substantial enough to affect the aquatic biota, but the increased flow in Little Cherry Creek would have a long-term benefit to that fishery.

3.6.4.3.3 Water Quality-Nutrients and Metals

In Alternative 3, all mine drainage water proposed for discharge to the LAD Areas would be pretreated, if necessary. The agencies assumed nitrate removal for the pretreatment system would be 90 percent. Predicted nutrient concentrations are lower than Alternative 2. Water released from the treatment facilities to a nearby stream would be required to meet the BHES Order and MPDES limits. The effect of any increase in TIN and ammonia would be the same as discussed for Alternative 2 (Table 64). The effect on aquatic life in metal concentrations would be the same as Alternative 2 (section 3.6.4.2.4, *Water Quality-Metals*). During mining, Alternative 3 would

not affect the existing water quality in Little Cherry Creek and, therefore, would have no effect on its aquatic life. Post-mining effects were described in sections 3.6.4.2.3, *Water Quality-Nutrients* and 3.6.4.2.4, *Water Quality-Metals*.

Changes in nutrient and metal concentrations in Rock Lake and St. Paul Lake would be the same as discussed for Alternative 2. Reduced productivity may be the most likely effect, reducing production in algae, macroinvertebrates, and fish.

3.6.4.3.4 Fish Passage and Fish Loss

During construction and operation of the mine, many of the same roads would be used for access to mine facilities in Alternative 3 as in Alternative 2. All bridges proposed for construction or upgrades would comply with INFS standards and guidelines, and would not impact fish passage. Additionally, culverts along a 13-mile segment of Bear Creek Road and along a 1.4-mile of the Libby Creek Road would be replaced as necessary to allow for fish passage. Culvert removal associated with access changes would improve fish passage in affected drainages. There would be no significant adverse effects to fish passage from mine activities in Alternative 3 and the replacement of existing culverts to improve fish passage under this alternative would provide a beneficial effect on fish. MMC would maintain one or more bulkheads underground if hydrologic modeling during initial mine operations (by Year 5 of operations) determined that bulkheads would minimize changes in East Fork Rock Creek and East Fork Bull River streamflows. The effect of reduced base flow on fish passage in East Fork Rock Creek and East Fork Bull River as well as St. Paul Lake and Rock Lake described in Alternative 2 would be less in Alternative 3. Effects of post-mine operation would be the same as Alternative 2.

3.6.4.3.5 Threatened and Endangered Species

Alternative 3 may affect bull trout and their habitat in analysis area streams during construction and operation of the mine. As with Alternative 2, potential short- and long-term impacts may result from increases in the amount of fine sediment. Many of these effects would be less than in Alternative 2 because the tailings impoundment would not require a stream diversion in Alternative 3, and fewer disturbances in RHCAs would occur.

The Wildlife Mitigation Plan and Fisheries Mitigation Plan in Alternative 3 discussed in section 3.6.4.3.1, *Sediment* would increase sedimentation in bull trout-occupied streams in the short term. After the activities were completed, and the roads became stabilized, habitat in bull trout-occupied streams would improve.

MMC would implement mitigation measures to offset the effects of possible flow changes in the Rock Creek and East Fork Bull River drainages. If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. MMC would complete a comprehensive aquatic habitat assessment from the confluence of the East Fork Bull River and Snake Creek along the extent of fish habitat in the East Fork Bull River about 1.3 miles past the CMW boundary. Following completion of the habitat inventory, MMC would construct instream structures forming pools and deep water habitat (>1.5 feet depth) from Snake Creek to a location 0.5 mile into the CMW. Work within the CMW would be limited to hand tools and would consist of mainly the addition of LWD. Trail #935 leading to Rock Lake would be converted from a motorized trail to a non-motorized trail, reducing its sediment contribution and increasing riparian habitat along the trail. These measures would improve the bull trout habitat in Rock Creek and the East Fork Bull River.

As with Alternatives 1 and 2, bull trout populations in analysis area streams would continue to be marginal and their habitat in need of restoration work from existing, non-project impacts in Alternative 3. Bull trout populations would continue to be susceptible to decline or disappearance due to hybridization with introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances.

Effects to Critical Habitat

No roads or other facilities are proposed in any designated critical habitat segment in Alternative 3. Alternative 3 would affect the same segments in East Fork Rock Creek and Rock Creek as Alternative 2. If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to East Fork Rock Creek streamflow. Alternative 3 would avoid construction of an impoundment in Little Cherry Creek and diversion of the creek. Effects on the designated critical habitat on Libby Creek below Little Cherry Creek would be same as Alternative 2 during operations, decreasing average annual flow by about 2 percent. Post-operations, Alternative 3 would not affect the designated critical habitat on Libby Creek below Little Cherry Creek.

Sedimentation in the designated segments would be minimized through access changes in the Rock Creek, Libby Creek, and Miller Creek watersheds, implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources in the Libby Creek watershed, and the installation of structures in bull trout critical habitat between Little Cherry Creek and Bear Creek. TIN, copper, and zinc concentrations are likely to be similar to Alternative 2 (sections 3.6.4.2.3, *Water Quality-Nutrients* and 3.6.4.2.4, *Water Quality-Metals*). These measures would decrease the risk of changes in water quantity, or increased sedimentation in designated critical habitat in Libby, Ramsey, and Poorman creeks.

3.6.4.3.6 Sensitive Species

Construction and Operation of Mine

Alternative 3 may adversely affect pure redband trout populations. Potential effects to the redband trout populations in the Libby Creek drainage would be less in Alternative 3 than in Alternative 2 (section 3.6.4.2.8, *Sensitive Species*). In Alternative 3, no diversion of Little Cherry Creek would be necessary, and the population in Little Cherry Creek would not be adversely affected. A small flow increase in Little Cherry Creek would result in a long-term benefit to the redband trout population in the creek. Redband trout in the remainder of the Libby Creek drainage are largely hybridized and effects are expected to be minimal and to be less than those predicted in Alternative 2 in many cases. Alternative 3 may impact westslope cutthroat trout populations in the Rock Creek and East Fork Bull River drainages and would be similar to Alternative 2 (section 3.6.4.2.8, *Sensitive Species*). The primary risk to both the redband and the westslope cutthroat populations would remain hybridization, which is unrelated to mine activities.

Post-mine Operations

Upon mine closure, reclamation of mine facility sites and roads would occur, and effects of mining activities on redband trout populations in the Libby Creek watershed are expected to be minimal. Surface runoff from the Poorman tailings impoundment would be directed toward Little Cherry Creek, and would likely cause some increases in stream sedimentation during construction of a check dam and diversion channel. Increased stream sedimentation would have a short-term adverse effect on redband trout population in Little Cherry Creek due to increased sediment in the water column and the substrate. These increases would be temporary, with most of the sediment flushed out of the system during high flow events, such as during snowmelt runoff or rain-on-

snow. Post-operation flows would substantially increase in Little Cherry Creek as the result of increases in watershed size, which may positively affect the pure redband trout in this stream in the long term. Short-term increases in sedimentation and scour may have an adverse effect on the redband population initially. Effects to westslope cutthroat trout in Rock Creek and the East Fork Bull River would be similar to Alternative 2 (section 3.6.4.2.8, *Sensitive Species*). If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Hybridization would remain the primary threat to both redband and westslope cutthroat populations.

3.6.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 2, with modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4.

3.6.4.4.1 Sediment

Construction and Operation of Mine

In general, potential sediment impacts would be reduced in Alternative 4 compared to Alternative 2 (section 3.6.4.2.1, *Sediment*), but would be similar or greater than those predicted for Alternative 3. Due to difficulties in quantifying any sediment increases and their effects on aquatic life for any of the alternatives, the extent of these differences is not known. Under Alternative 4, the permit and disturbance boundaries for the Little Cherry Creek Tailings Impoundment Site would be modified to reduce effects on RHCAs in this drainage. Alternative 4 would affect 206 acres of RHCAs on National Forest System lands and 143 acres of other riparian areas on private lands (Table 63). Because RHCAs are designed to act as buffers to protect the streams from sediment as well as other impacts, fewer disturbances within these areas would reduce the amount of sediment that would reach the streams, particularly during the construction phase when the sedimentation impacts are expected to be the most severe.

The diversion channel in Alternative 4 would be constructed to minimize erosion. Some periodic increases in sediment in the lower channels and Libby Creek would occur, particularly during storm events. As discussed in section 3.6.4.2.1, *Sediment*, these increases would be expected to only persist in the short term because much of the sediment would likely be flushed out of the upper Libby Creek drainage by the high flows. The probability of catastrophic failure of the tailings impoundment is low, but if it were to occur, short- and long-term effects would occur to the aquatic habitat and aquatic life as described in Alternative 2 (section 3.6.4.2.1, *Sediment*).

The mitigation plans for Alternative 4 regarding sediment reduction would be the same as Alternative 3 (section 3.6.4.3.1, *Sediment*). Proposed road and trail access changes and implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources would minimize the net contribution of sediment to the Libby Creek watershed.

Post-mine Operations

Minimal increases in sedimentation would be expected in Alternative 4 once mine operations ceased. Additional sedimentation of the diversion channels may occur as the channels re-established to accommodate runoff from the tailings impoundment. Any sedimentation would

adversely affect the transplanted redband trout population in diverted Little Cherry Creek. The increase in sediment in Bear Creek in Alternative 2 from surface runoff from the tailings impoundment would not occur in Alternative 4. All short- and long-term reclamation objectives in Alternative 2 are retained in Alternative 4, and all of the erosion and sediment control measures described in Alternative 2 and 3 also would be implemented.

3.6.4.4.2 Water Quantity

Alternative 4 is essentially the same as Alternative 3, with the exception being the location of the tailings impoundment in the Little Cherry Creek drainage rather than north of Poorman Creek. Flow-related habitat changes in East Fork Rock Creek and East Fork Bull River as a result of construction and mining, including proposed mitigation, would be the same as those described in Alternative 3. Effects on Libby Creek and its tributaries except Little Cherry Creek would be similar to those of Alternative 2 (section 3.6.4.3.2, *Water Quantity*). As in Alternative 2, average flow in the diverted Little Cherry Creek would be about 60 percent of the original Little Cherry Creek. The loss of available habitat in the diverted Little Cherry Creek would adversely affect the redband trout population in the diverted creek because the remaining habitat would not likely support the population at its current numbers.

Alternative 4 post-mining effects would be similar to Alternative 3 (section 3.6.4.3.2, *Water Quantity*) except for effects to diverted Little Cherry Creek and former Little Cherry Creek. Surface runoff from the impoundment would be directed to the diverted Little Cherry Creek and flows would be greater than flows during operations. Average flow in the diverted creek would be about 90 percent of the original Little Cherry Creek flows. The higher flows would provide better habitat than during operations, but slightly less than currently in Little Cherry Creek.

3.6.4.4.3 Water Quality-Nutrients and Metals

As with Alternatives 2 and 3, increased nutrient and metal concentrations may occur in analysis area streams in the Libby Creek watershed (sections 3.6.4.2.3, *Water Quality-Nutrients* and 3.6.4.2.4, *Water Quality-Metals*). The effects on aquatic life would be the same as Alternative 3.

3.6.4.4.4 Toxic Metals in Fish

Changes in metal concentrations in fish would be the same as discussed for Alternative 2 (section 3.6.4.2.5, *Toxic Metals in Fish*).

3.6.4.4.5 Fish Passage and Fish Loss

Construction and Operation of Mine

Streams

Many of the same roads would be used for access to mine facilities in Alternative 4 as in Alternative 2. As in Alternative 3, all proposed construction or upgrades to bridges would comply with INFS standards and guidelines and KNF BMPs, and culverts along 13-mile segment of the Bear Creek Road and a 1.4-mile segment of the Libby Creek Road and Upper Libby Creek Road would be replaced as necessary to allow for fish passage. Culvert removal associated with road closures also would improve fish passage. As with Alternative 3, there would be beneficial effects to fish passage from mine activities in Alternative 4.

The Diversion Channel would be designed for fish passage, which would provide better fish habitat than Alternative 2. The same procedures for removal of fish from the portion of Little Cherry Creek under the tailings impoundment would be followed, as in Alternative 2, and the fish

would be placed back into diverted Little Cherry Creek following the watering of the diversion ditch. Some fish mortality is possible from handling stress through removal and replacement methods, but would be minimal. Changes in fish passage in East Fork Bull River and Rock Creek drainages would be the same as Alternative 3 (section 3.6.4.3.4, *Fish Passage and Fish Loss*).

Post-mine Operation

There would be minor effects on aquatic populations due to stream crossings once the mine closed and reclamation was completed. Changes in the streams and lakes of the East Fork Bull River and Rock Creek drainages would be the same as Alternative 3 (section 3.6.4.3.4, *Fish Passage and Fish Loss*).

3.6.4.4.6 Threatened and Endangered Species

Construction and Operation of Mine

Streams

Alternative 4 may affect bull trout. Adverse effects to bull trout populations are possible in Alternative 4 from increases in the amount of fine sediment, increases in stream concentrations of nutrients and copper and zinc, and possible bioaccumulation of metals that may occur in the Libby Creek watershed as a result of mine activities. These effects are expected to be less in Alternative 4 than Alternative 2. The diversion of Little Cherry Creek is expected to have minimal direct effects on the bull trout populations within the Libby Creek drainage because bull trout do not access that portion of Little Cherry Creek. The risk of sedimentation or increased temperatures from decreased riparian shading would be greater than Alternative 3 and similar to Alternative 2. Due to its isolation, the bull trout population in Libby Creek is particularly susceptible to degradation of stream habitat or water quality.

The Wildlife Mitigation Plan and Fisheries Mitigation Plan in Alternative 4 would be the same as Alternative 3 (section 3.6.4.3.1, *Sediment*) and would benefit bull trout populations in the Libby Creek watershed. Objectives of this mitigation plan include reducing sediment sources and bank erosion, stabilizing the stream channel, and improving habitat for bull trout and redband trout. As in all alternatives, bull trout populations in the Libby Creek watershed would continue to be marginal as a result of non-project impacts such as hybridization and competition with non-native trout present within the drainage.

Effects to bull trout populations in the Rock Creek and East Fork River drainages are predicted to be the same in Alternative 4 as in Alternative 3 (section 3.6.4.3.5, *Threatened and Endangered Species*). There is the potential for adverse long-term and short-term effects to bull trout populations from the decreased flows in these drainages.

Lakes

Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Post-mine Operation

Streams

Once mine operations ceased, mine facility sites and roads would be reclaimed, and bull trout habitat in the Libby Creek watershed would return to pre-mine or better than pre-mine conditions, given the habitat improvement work. Hybridization and competition with brook trout would

continue to be a threat to bull trout populations in the Libby Creek watershed. As in Alternative 3, if necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Adverse impacts to bull trout populations due to flow changes in Rock Creek and the East Fork Bull River are predicted to continue during post-mine operations.

Lakes

Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Effects to Critical Habitat

No roads or other facilities are proposed in any designated critical habitat segment in Alternative 4. Alternative 4 would affect the same four segments in East Fork Rock Creek and Rock Creek and the segments in Libby Creek as Alternative 2 (section 3.6.4.2.7, *Threatened and Endangered Species*). Effects on the designated critical habitat on Libby Creek below Little Cherry Creek would be same as Alternative 2 during operations, decreasing average annual flow by about 2 percent. Post-operations, Alternative 3 would not affect the designated critical habitat on Libby Creek below Little Cherry Creek. The mitigation measures in Alternative 3 would be implemented, and would decrease the risk of changes in water quality, water quantity, or increased sedimentation in designated critical habitat in Libby, Ramsey, and Poorman creeks.

3.6.4.4.7 Sensitive Species

All Phases

Streams and Lakes

Alternative 4 may impact redband trout. Effects to the hybrid redband trout populations within the Libby Creek drainage in Alternative 4 would be similar to effects described in Alternative 2 (section 3.6.4.2.8, *Sensitive Species*). The diversion drainage would have higher flow post-mining and be designed for fish passage, which would provide better fish habitat than Alternative 2. The effects of the proposed mitigation plan would be the same as Alternative 3. Effects on westslope cutthroat trout would be the same in Alternative 4 as in Alternative 2 (section 3.6.4.2.8, *Sensitive Species*).

3.6.4.5 Alternative A – No Transmission Line Alternative

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Possible impacts to aquatic resources due to construction, operation, and maintenance of a new transmission line would not occur. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.6.4.6 Alternative B – North Miller Creek Transmission Line Alternative

MMC's proposed alignment for the transmission line would be in the Fisher River, Miller Creek, and Libby Creek watersheds. The proposed alignment would follow the Fisher River and U.S. 2 north from the substation for 4 miles, with the alignment turning west to generally follow the

Miller Creek drainage for 2.5 miles. It would then traverse a tributary to Miller Creek, cross into the upper Midas Creek drainage, and then down to Libby Creek and Ramsey Creek. This alternative would potentially cause the greatest amount of disturbance close to a stream. None of the transmission line alternatives have any effect on analysis area lakes; only the effects of the alternatives on stream habitat and aquatic populations in area streams are discussed. The transmission line would be removed following mine closure and reclamation, resulting in additional disturbance. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine; any long-term effect from these activities on the aquatic habitat and populations would be minor.

3.6.4.6.1 Sediment

A construction Storm Water Pollution Prevention Plan would be developed and implemented to minimize the discharge of pollutants resulting from Alternative B. Structural and non-structural BMPs would be implemented to minimize stream sedimentation. The primary sources of sediment during construction of the transmission line would include timber clearing, road construction, and road upgrades. The transmission line would span six streams: Hunter Creek, Fisher River, unnamed tributary of Miller Creek, Howard Creek, Libby Creek, and Ramsey Creek. In Alternative B, two structures would be located immediately adjacent to the Fisher River and sediment would likely reach the river despite BMPs to reduce sediment transport. Similarly, the access road between these two structures would introduce sediment to the Fisher River because the road would be located adjacent to the river. Two other structures would be located immediately adjacent to Miller Creek (Figure 42). Construction would introduce sediment to Miller Creek. Stream crossings would be constructed to meet KNF and DEQ requirements. Disturbance on active floodplains would be minimized to reduce sedimentation to streams during annual runoff, and construction activities would be curtailed during heavy rains to reduce erosion.

Road Construction and Reconstruction

Section 3.18, *Soils and Reclamation* discusses the effects on highly erodible soils and soils with high sediment delivery. Alternative B would disturb 8.9 acres for new access roads or roads with high upgrade requirements on soils having severe erosion risk, the majority of which occur along Libby and Miller creeks and Fisher River (Table 134). Most soils with high sediment delivery potential disturbed by access roads occur along Ramsey, Libby, and Miller creeks and Fisher River (Figure 82). Some sediment increases would occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize impacts during construction.

All transmission line alternatives would require the construction of new roads. Road construction would be the primary contributor to sediment in area streams. Alternative B would require 9.9 miles of new road construction (Table 66). One major stream (the unnamed tributary of Miller Creek that Alternative B follows) and four minor unnamed tributary streams would be crossed by new roads in Alternative B (Table 66). An analysis was made of the combined effects of the mine alternatives with the transmission line alternatives from new road construction. The combination of mine alternative 2 and transmission line alternative B would require the most new road construction (17.2 miles). New road construction in the other mine and transmission line alternative combinations would be less, ranging from 9.3 miles to 10.1 miles (Table 66).

Table 66. Stream Crossings and New Road Requirements by Alternatives and Alternative Combinations.

Alternatives	Number of Stream Crossings by Transmission Line		Number of Stream Crossings by New Roads		Miles of New Road Construction
	Major Stream	Minor Stream	Major Stream	Minor Stream	
Transmission Line Alternatives					
B	6	16	1	4	9.9
C	6	13	0	3	3.0
D	8	13	0	5	3.3
E	9	13	0	4	3.5
Combined Mine and Transmission Line Alternatives					
2 B	6	16	4	5	17.2
3 C	6	13	1	4	9.3
3 D	8	13	1	6	9.6
3 E	9	13	1	5	9.8
4 C	6	13	2	4	9.6
4 D	8	13	2	6	9.9
4 E	9	13	2	5	10.1

Source: GIS analysis by ERO Resources Corp. using KNF data.

Riparian Areas

Clearing vegetation, constructing new roads, and upgrading roads in Alternative B would disturb 31 acres of RHCAs on National Forest System lands and 33 acres of other riparian areas on private land (Table 67). Sediment delivery would likely increase substantially, stream habitat would be altered in the short term and, consequently, fish and other aquatic populations would be adversely affected as well. The pure redband trout population in the Fisher River and the pure westslope cutthroat trout in Miller Creek may be adversely affected by sediment increases under this alternative, at least in the short term. Trout and sculpin populations in the other streams could also be affected.

An analysis was made of the combined effects of the mine alternatives with the transmission line alternatives on RHCAs on National Forest System lands and other riparian areas on private and state lands. Effects on RHCAs on National Forest System lands would range from 176 acres with mine Alternative 3 and transmission line Alternative C to 277 acres for mine Alternative 2 and transmission line Alternative B (Table 68). Much of the “other private” land affected by combinations with mine Alternatives 2 and 4 is owned by MMC in the Little Cherry Creek Impoundment Site.

Table 67. Effects on RHCAs and Riparian Areas by Transmission Line Alternatives.

	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Riparian Areas within Clearing Area[†]				
RHCAs on National Forest System lands (ac.)	31	18	56	36
Other riparian areas on private or state lands (ac.)	33	22	26	27
Total (ac.)	64	40	82	63
Number of Structures within Riparian Areas[‡]				
RHCAs on National Forest System lands	7	2	5	5
Other riparian areas on private or state lands	12	4	4	8
Total	19	6	9	13

[†]Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot-width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.
New and upgraded roads are included in the acreage.
INFS standards apply only to National Forest System lands.
[‡]Number and location of structures are based on preliminary design.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 68. Effects on Riparian Areas by Combination of Mine and Transmission Line Alternatives.

Combination of Alternatives	RHCAs on National Forest System Lands	Other Riparian Areas			Total
		State	Plum Creek Timber Company	Other Private	
2 and B	277	0	33	148	458
3 and C	176	0	22	9	208
3 and D	214	0	22	14	249
3 and E	194	12	15	9	231
4 and C	247	0	51	143	441
4 and D	261	0	22	147	431
4 and E	242	12	15	143	412

All units are in acres. Acreage is based the disturbance area for mine alternatives and, for transmission line alternatives, on a 150-foot clearing width for monopoles (Alternative B) and 200-foot-width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope and line clearance above the ground.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Roads opened or constructed for transmission line access would be closed after the transmission line had been built. The road surface would be reseeded as an interim reclamation activity designed to stabilize the surface. Where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded. Sediment delivery would decrease following reseeding. Transmission line maintenance may periodically result in short-term sediment increases to streams at locations where the transmission line was located adjacent to or crossed streams. Transmission line decommissioning also would result in a short-term sediment increase to the streams.

3.6.4.6.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would increase by 8.6 percent for Ramsey Creek, with a combination of Alternative 2 and the transmission line Alternative B. All other stream peak flows in the analysis area would not be affected by Alternative B. This small percent increase would not result in any changes to fish habitat in Ramsey Creek.

3.6.4.6.3 Threatened, Endangered, or Sensitive Species

Alternative B may affect bull trout and their habitat. Vegetation clearing and road construction during construction would result in short-term increases of sediment in the Fisher River and Libby Creek drainages occupied by bull trout. Substantial increases in fine sediment are unlikely to occur past the construction period, except during line decommissioning when short-term increases are expected. Following Environmental Specifications and using BMPs would minimize impacts.

Alternative B may affect designated bull trout critical habitat. Alternative B would cross Howard Creek and Libby Creek about 0.3 mile upstream of designated critical habitat in Libby Creek below the confluence with Howard Creek. Vegetation clearing and road construction during construction would result in short-term increases of sediment in this designated section. Similar effects would occur during line decommissioning.

Alternative B may affect redband trout and westslope cutthroat trout. The pure and hybrid redband trout populations that exist in the Fisher River, Miller Creek, and Libby Creek drainages may be adversely affected by releases of fine sediment that occur from the land clearing and road construction necessary for transmission line installation. A pure westslope cutthroat trout population is found in Miller Creek. The population may be affected in a manner similar to the hybrid redband trout population. Following Environmental Specifications and using BMPs would minimize impacts.

3.6.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

The primary modification in Alternative C to MMC's proposed North Miller Creek Alternative would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification results in the transmission line crossing less area with soils that are highly erosive and subject to high sediment delivery and slope failure. H-frame poles, which generally allow for longer spans and fewer structures and access roads, would be used for this alternative. In some locations, a helicopter would be used to place the structures. As in Alternative B, transmission line construction and operation are not expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure,

resulting in additional disturbance. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine; any long-term effect from these activities on the aquatic habitat and populations would be minor.

3.6.4.7.1 Sediment

Compared to Alternative B, Alternative C has numerous changes that would reduce effects on aquatic life in streams along the transmission line corridor:

- Fewer structures and access roads in the Fisher River floodplain
- Fewer structures and access roads on highly erodible soils
- Fewer structures and access roads in RHCAs
- Structures farther from Miller Creek
- Placement into intermittent stored service of all new roads on National Forest System lands
- Use of helicopter for structure placement and vegetation clearing in some areas
- Implementation of a Vegetation Removal and Disposition Plan to reduce clearing
- Limited use of heavy equipment in RHCAs

Road Construction and Reconstruction

The modifications incorporated into Alternative C would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads, and decreasing erosion by altering the alignment of the transmission line. Stream crossings of the transmission line would be the same as Alternative B (Table 66), except Sedlak Creek would be crossed and Ramsey Creek would not be. No major streams and three smaller tributaries would be crossed by new roads in Alternative C (Table 66). New access roads and closed roads with high upgrade requirements in Alternative C would disturb 4.2 acres of soils having severe erosion risk, and 1.5 acres of soils with high sediment delivery potential (Table 134). Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, and along Miller Creek and near the Fisher River crossing (Figure 82). Soils having high sediment delivery potential along access roads occur along Libby and Miller creeks and at the northeast end along the Fisher River. Most soils having potential for slope failure along access roads occur just east of Libby Creek, along Miller Creek and east of Fisher River. Some sediment increases would occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize any impacts during the construction period.

Alternatives C, D, and E would include the placement of NFS road #4725 into long-term intermittent stored status. Mitigation would reduce sediment contribution from this road.

Riparian Areas

Alternative C would 18 acres of RHCAs on National Forest System lands and 22 acres of other riparian areas on private lands (Table 67). Based on a preliminary design, four structures would be in a RHCA on National Forest System lands and two structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, and using a helicopter for line stringing, logging, and decommissioning new

access roads on National Forest System lands after construction would reduce contributions of sediment to area streams. Some periodic sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be substantially less than in Alternative B. MMC would use the same general methods to operate, maintain, and reclaim the line and access roads as in Alternative B. Effects of sediment on fish populations of the four streams would be less than the effects of Alternative B (section 3.6.4.6.1, *Riparian Areas*).

3.6.4.7.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative C. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.7.3 Threatened, Endangered, or Sensitive Species

Alternative C may affect bull trout, hybrid redband trout, and hybrid westslope cutthroat trout populations and their habitat in area drainages. The measures discussed in section 3.6.4.7.1, *Sediment* would minimize impacts on bull trout, redband trout, and westslope cutthroat trout populations. Alternative C may affect designated bull trout critical habitat. Effects of Alternative C on critical habitat downstream of the Howard Creek and Libby Creek confluence would be the same as Alternative B (section 3.6.4.6.3, *Threatened, Endangered, or Sensitive Species*). Fisheries mitigation described for mine Alternative 3 (section 3.6.4.3.1, *Sediment*) would offset these effects.

3.6.4.8 Alternative D – Miller Creek Transmission Line Alternative

This alternative modifies MMC's proposal using the measures described for Alternative C (3.6.4.7.1, *Sediment*). Instead of being routed along an unnamed tributary of Miller Creek, the alignment would follow along Miller Creek into the Howard Creek drainage. As in Alternative B, transmission line construction and operation are not expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure and reclamation, resulting in additional disturbance. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine; any long-term effect from these activities on the aquatic habitat and populations would be minor.

3.6.4.8.1 Sediment

The modifications incorporated into Alternative D would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads and decreasing erosion by altering the transmission line alignment. The transmission line would cross eight streams: Sedlak Creek, Hunter Creek, Fisher River, unnamed tributary to Miller Creek, Miller Creek, Howard Creek twice, and Libby Creek (Table 66).

Road Construction and Reconstruction

Alternative D would require 3.3 miles of new roads (Table 66). This alignment also would cross less area with soils that are highly erosive and subject to high sediment delivery and slope failure than Alternative B (Table 134). New access roads and closed roads with high upgrade requirements would disturb 4.2 acres of soils having severe erosion risks, and 1.5 acres of soils with high sediment delivery potential (Table 134). Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, along Miller Creek and Fisher River. The majority of soils with high sediment delivery potential along access roads occur along Libby and Miller creeks and at the northeast end along the Fisher

River (Figure 82). No major streams and five smaller tributaries would be crossed by new roads in Alternative D (Table 66). Some sediment increases would occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize any impacts during the construction period.

Riparian Areas

Disturbance within riparian areas would be greater than Alternative B, with 56 acres of RHCAs on National Forest System lands and 26 acres of other riparian areas on private lands (Table 67). Based on a preliminary design, five structures would be in a RHCA on National Forest System lands and four structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, and using a helicopter for line stringing and site clearing would minimize contributions of sediment to area streams.

3.6.4.8.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative D. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.8.3 Threatened, Endangered, or Sensitive Species

Effects on bull trout and redband trout would be the same as Alternative C (section 3.6.4.7.3, *Threatened, Endangered, or Sensitive Species*). More structures would be near Miller Creek than Alternatives B and C, potentially affecting the pure westslope cutthroat trout population in Miller Creek.

Alternative D may affect designated bull trout critical habitat. Alternative D would cross Howard Creek about 0.4 mile upstream and Libby Creek about 0.3 mile upstream of designated critical habitat in Libby Creek below the confluence with Howard Creek. Vegetation clearing and road construction during construction would result in short-term increases of sediment in this designated section. Similar effects would occur during line decommissioning. Fisheries mitigation described for Alternative 3 (section 3.6.4.3.1, *Sediment*) would offset these effects.

3.6.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

This alternative modifies MMC's proposed North Miller Creek alignment by routing the line east to generally follow West Fisher Creek. H-frame poles, which generally allow for longer spans and fewer structures and access roads, would be used for this alternative. Alternative E includes measures described for Alternative C (section 3.6.4.7.1, *Sediment*) except for the modifications along Miller Creek. As in Alternative B, transmission line construction and operation are not expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure and reclamation, resulting in additional disturbance. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine. Any effects from these activities on the aquatic habitat and populations would be minor post-operation.

3.6.4.9.1 Sediment

The modifications incorporated into Alternative E would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads and decreasing erosion by altering the transmission line alignment. The transmission line would cross nine

streams: Sedlak Creek, Hunter Creek, Fisher River, West Fisher Creek, two unnamed tributaries of West Fisher Creek, Howard Creek twice, and Libby Creek (Table 66). This alignment also would cross less area with soils that are highly erosive and subject to high sediment delivery and slope failure than the other alternatives (Table 134).

Road Construction and Reconstruction

Alternative E would require 3.5 miles of new roads (Table 66). New access roads and closed roads with high upgrade requirements would disturb 3.1 acres of soils having severe erosion risks (Table 134), which occur primarily along occur along Libby and West Fisher creeks and Fisher River (Figure 82). This alternative would affect very few soils with high sediment delivery potential (0.5 acre). No major streams and four smaller tributaries would be crossed by new roads in Alternative E (Table 66). Some sediment increases would occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize any impacts during the construction period.

Riparian Areas

Disturbance within riparian areas would be more than Alternative B, with 36 acres of RHCAs on National Forest System lands and 27 acres of other riparian areas on private or state lands (Table 67). Based on a preliminary design, five structures would be in a RHCA on National Forest System lands and eight structures would be in a riparian area on private or state lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, and using a helicopter for line stringing and site clearing would minimize contributions of sediment to area streams.

3.6.4.9.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative E. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.9.3 Threatened, Endangered, or Sensitive Species

Alternative E may affect bull trout and redband trout and their habitat. Effects on redband trout would be similar to Alternatives C and D. Alternative E would have more effect on bull trout than the other alternatives. About 6 miles of line and 1.5 miles of new or upgraded access roads would be in the Fisher River and West Fisher Creek watersheds, which provide occupied bull trout habitat. Measures described for Alternative C (section 3.6.4.7.1, *Sediment*), except for the modifications along Miller Creek, would minimize effects.

Alternative E would follow West Fisher Creek for about 5 miles; two segments of designated bull trout critical habitat are located in the creek (Figure 56). The existing Libby Creek Road (NFS road #231) would be between the creek, and the transmission line and any newly constructed roads. There would be increased sedimentation during construction and decommissioning activities. Bull trout critical habitat would be adversely affected during these times. Effects of Alternative E on the critical habitat downstream of the Libby Creek and Howard Creek confluence would be the same as Alternative D (section 3.6.4.8.3, *Threatened, Endangered, or Sensitive Species*). Fisheries mitigation described for Alternative 3 (section 3.6.4.3.1, *Sediment*) would offset these effects.

3.6.4.10 Cumulative Effects

Cumulative effects in the analysis area include past and current actions that are likely to continue in the future and reasonably foreseeable actions that could affect aquatic biota. This includes other area mining activities, particularly instream suction dredging and placer exploration, which in the past have created physical substrate habitat alterations in area streams. Suction dredging tends to destabilize stream channels and may alter streamflows, particularly during high flows. There are also ongoing and planned mine reclamation activities. Other activities that could affect the aquatic biota include timber harvesting, land clearing, home construction, road construction, septic field installation, water well drilling, livestock grazing, and stream channel and bank stabilization or restoration projects. These activities can either have adverse or beneficial effects to the aquatic biota.

The ground water numerical model was used to predict base flow changes to streams due to implementing both the Montanore and Rock Creek Projects. Effects to streamflow would remain the same for Libby and Ramsey creeks. In Rock Creek, about 1.25 miles downstream of Rock Lake, decreased base flow would be greater with operation of the Rock Creek Project. In the East Fork Bull River, decreased base flow would be greater throughout the length of the stream during mining and also would decrease post-mining. When placed into the context of a likely loss of habitat under MMC alternatives, the cumulative effects would result in additional habitat loss downstream of Rock Lake and St. Paul Lake including the bull trout spawning period. Habitat improvements in the East Fork Bull River would offset the habitat loss associated with the Montanore Project.

No impacts related to the Rock Creek Project are anticipated in the Bull River drainage, which is considered to be the principal contributor of the core area, because it supports relatively strong numbers of adfluvial, fluvial, and resident bull trout. Impacts of the Rock Creek Project are anticipated to only affect the local population of bull trout in Rock Creek, and these impacts are expected to result from sediment delivery during the construction period and 2 years following. The effect of sediment intrusion into the stream channel should be minimized by the proposed sediment abatement measures and vegetation buffer zones. Risks to bull trout could increase if the Rock Creek Project causes water quality and water quantity changes that affect streamflows in Rock Creek. It is difficult to determine with any certainty whether a risk to bull trout would exist under project implementation because of the lack of data or pertinent scientific information on the relationship of underground mining effects on aquatic species (USFWS 2007a).

In Rock Creek, the functioning of the core area population would be maintained and the risk from natural environmental changes would be unaffected. This is largely because of the strength and stability of the remaining local populations, the relatively small contribution of Rock Creek bull trout to the core area population, and the recovery efforts now underway with fish passage and habitat restoration activities addressing the main threats to the core area population. There may be a slight slowing in the rate of recovery for the core area population because of the slight loss in recruitment potential, but if current efforts to recover the adfluvial component under the Avista program continue to be successful and overshadow the potential loss, the recovery rate of the core area may not be affected (USFWS 2007a).

The Avista fish passage program is well-funded with full-time dedicated staff to implement the trap and transport of bull trout for the entire 45-year licensing period. The Avista program has identified and implemented habitat acquisition and restoration projects as funding allows.

Cooperative efforts between Avista, FWP, and local watershed groups are providing long-term habitat protection through land acquisition, conservation easements, and watershed restoration. Fragmentation of the historical migratory populations in the lower Clark Fork River was considered the highest risk, but this threat has been addressed with consolidation of four core areas into one (Lower Clark Fork Core Area) as a result of the success of the Avista fish passage program (USFWS 2007a)

Any loss of bull trout from these cumulative impacts would represent an irretrievable loss of genetic diversity. Improvements in habitat quality and productivity due to natural processes over time would potentially be adversely affected by the cumulative effects of continued forestry activities. Timber harvest, past placer mining, possible private land development, future mining activities, and continued recreational use also may inhibit fish population increases.

3.6.4.11 Regulatory/Forest Plan Consistency

3.6.4.11.1 Endangered Species Act

All action alternatives may affect and are likely to adversely affect the bull trout and designated bull trout critical habitat. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF will submit a BA to the USFWS that describes the potential effect on threatened and endangered species that may be present in the area. After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

3.6.4.11.2 Kootenai Forest Plan

Sensitive Species

None of the mine or transmission line alternatives would likely contribute to a trend toward federal listing or cause loss of viability of the population of westslope cutthroat trout or interior redband trout. Transmission line construction would result in short-term increases in sedimentation. The transmission line would be removed following mine closure and reclamation, resulting in additional disturbance. BMPs would help minimize the amount of sediment reaching the streams. Identification and implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources would minimize the net effect of the alternatives on sediment concentrations. The reduction in habitat for the interior redband trout in Little Cherry Creek in Alternatives 2 and 4 would not likely contribute to a trend toward federal listing or cause loss of viability of the population. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine. Any effects from these activities on the aquatic habitat and populations would be minor post-operation. In summary, this effects analysis demonstrates that the effects of implementing the Alternatives 2, 3, or 4 may impact individuals but would not likely contribute to a trend toward federal listing or cause loss of viability of the population of westslope cutthroat trout or interior redband trout.

Riparian Habitat Conservation Areas

This section discusses compliance with the following RHCA standards and guidelines:

- Timber management (TM-1)
- Roads management (RF-2 through RF-5)
- Minerals management (MM-1, MM-2, MM-3, and MM-6)

- Lands (LH-3)
- General riparian area management (RA-2 through RA-4)
- Watershed and habitat restoration (WR-1)
- Fisheries and wildlife restoration (FW-1)

Timber Management (TM-1)

Standard
Prohibit timber harvest, including fuelwood cutting, in Riparian Habitat Conservation Areas, except as described below:

a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in Riparian Habitat Conservation Areas only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects can be avoided to inland native fish. For priority watersheds, complete watershed analysis prior to salvage cutting in RHCAs.

Mine Alternatives
Alternative 2. Under Alternative 2, the disturbance area for LAD Area 2 would be within a RHCA along Ramsey Creek. Compliance with TM-1 would be achieved through minimizing timber harvest in RHCAs and favoring riparian species and hardwoods.

Alternatives 3 and 4. Alternatives 3 and 4 would comply with TM-1. The disturbance areas for LAD Area 2 would be modified to avoid disturbance of the RHCA along Ramsey Creek.

Road Management (RF-2)

Standard
For each existing or planned road, meet the Riparian Management Objectives and avoid adverse effects to inland native fish by:

a. completing watershed analyses prior to construction of new roads or landings in Riparian Habitat Conservation Areas within priority watersheds.

b. minimizing road and landing locations in Riparian Habitat Conservation Areas.

c. initiating development and implementation of a Road Management Plan or a Transportation Management Plan. At a minimum, address the following items in the plan:

1. Road design criteria, elements, and standards that govern construction and reconstruction.

2. Road management objectives for each road.

3. Criteria that govern road operation, maintenance, and management.

4. Requirements for pre-, during-, and post-storm inspections and maintenance.

5. Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives.

6. Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control.

7. Mitigation plans for road failures.

d. avoiding sediment delivery to streams from the road surface.

1. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is infeasible or unsafe.

2. Route road drainage away from potentially unstable stream channels, fills, and hillslopes.

e. avoiding disruption of natural hydrologic flow paths.

f. avoiding sidecasting of soils or snow. Sidecasting of road material is prohibited on road segments within or abutting RHCAs in priority watersheds.

Road width in all new and reconstructed roads would be the minimum necessary to provide for safe and efficient use. The KNF has implemented several actions independent of the Montanore Project to meet RMOs associated with road management. The Libby Ranger District completed a Roads Analysis Report for the Libby Ranger District that established road design criteria, elements, and standards that govern construction and reconstruction and developed management objectives for existing roads. The report provided a descriptive ranking of the problems and risks associated with the current road system, and a list of prioritized opportunities for addressing identified problems and risks (KNF 2005).

Mine Alternatives

Alternative 2. MMC would minimize road crossings in RHCAs and would implement BMPs to minimize sediment delivery to crossed streams. All debris removed from the road surfaces except snow and ice would be deposited away from the stream channels. Snow removal would be conducted in a manner to minimize damage to travelways, prevent erosion damage, and preserve water quality. No side casting near stream crossings and bridges would occur, or be implemented as directed by the agencies. Alternative 2 would not be in compliance with RF-2c, because MMC's Plan of Operations does not address all items required by RF-2c. MMC's Plan of Operations also does not address the Libby Creek Road (NFS road #231) that would be used during the evaluation phase, and while the Bear Creek Road was being reconstructed.

Alternatives 3 and 4. Alternatives 3 and 4 would be in compliance with RF-2 because they provide for the development and implementation of a final Road Management Plan. MMC would develop for the lead agencies' approval, and implement a final Road Management Plan that would describe for all new and reconstructed roads the following:

- Criteria that govern road operation, maintenance, and management
- Requirements of pre-, during-, and post-storm inspection and maintenance
- Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives
- Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control

- Mitigation plans for road failures

The plan would describe management of road surface materials during plowing, such as snow and methods to control road ice. Sidecasting of soils or snow would be avoided. Sidecasting of road material would be prohibited on road segments within or abutting RHCAs. Culverts along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231) that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows.

Transmission Line Alternatives
Alternative B. Compliance with RF-2 would be the same as Alternative 2 (see previous discussion in this section). Alternative B would not in compliance with RF-2c, because MMC's Plan of Operations does not address all items required by RF-2c.

Alternatives C, D, and E. Compliance with RF-2 would be the same as Alternatives 3 and 4 (see previous discussion in this section). Alternatives C, D, and E would in compliance with RF-2 because they provide for the development and implementation of a Road Management Plan, as discussed under Alternatives 3 and 4.

Road Management (RF-3)

Standards
Determine the influence of each road on the Riparian Management Objectives. Meet Riparian Management Objectives and avoid adverse effects on inland native fish by:

a. reconstructing road and drainage features that do not meet design criteria or operation and maintenance standards, or that have been shown to be less effective than designed for controlling sediment delivery, or that retard attainment of Riparian Management Objectives, or do not protect priority watersheds from increased sedimentation.

b. prioritizing reconstruction based on the current and potential damage to inland native fish and their priority watersheds, the ecological value of the riparian resources affected, and the feasibility of options such as helicopter logging and road relocation out of Riparian Habitat Conservation Areas.

c. closing and stabilizing or obliterating, and stabilizing roads not needed for future management activities. Prioritize these actions based on the current and potential damage to inland native fish in priority watersheds, and the ecological value of the riparian resources affected.

Mine Alternative 2 and Transmission Line Alternative B. Compliance with RF-3 would be achieved by controlling sediment delivery through BMPs on new roads, reconstructing drainage features on existing roads if necessary, and obliterating and stabilizing roads not needed in the active mining phase after mine closure and removal of the transmission line. Road design features and BMPs designed to INFS riparian goals include chip sealing of the main access road; regular maintenance of unimproved roads; construction of bridges on main stream crossings versus culverts; placement of the tailings pipeline outside any RHCAs; installation of sediment traps and other structures as part of the stormwater and surface water runoff plan; and minimization of any stream activities during road construction (MMI 2006). MMC's Plan of Operations did not address drainage features along the Libby Creek Road (NFS road #231) that would be used while the Bear Creek Road was being reconstructed.

Mine Alternatives 3 and 4, and Transmission Line Alternatives C, D, and E. In mine Alternatives 3 and 4, compliance with RF-3 would be the same as Alternative 2 (see previous paragraph) except as follows. Culverts along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231) that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows.

In transmission line Alternatives C, D, and E, compliance with RF-3 would be the same as Alternative B (see previous discussion in this section) except as follows. The status of the transmission line roads on National Forest System lands would be changed to intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. Intermittent stored service roads would require some work to return them to a drivable condition. A culvert on roads used for maintenance access would be installed on any stream flowing at the time of use, if a culvert were not already in place. Intermittent stored service road treatments would include:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities
- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function
- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

Transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. In addition to all of the intermittent stored service road treatments, a decommissioned road would be treated by one or more of the following measures:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary
- Stabilizing fill slopes
- Obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism

- Removing unstable fills

Road Management (RF-4)

Standard
Construct new, and improve existing, culverts, bridges, and other stream crossings to accommodate a 100-year flood, including associated bedload and debris, where those improvements would/do pose a substantial risk to riparian conditions. Substantial risk improvements include those that do not meet design and operation maintenance criteria, or that have been shown to be less effective than designed for controlling erosion, or that retard attainment of Riparian Management Objectives, or that do not protect priority watersheds from increased sedimentation. Base priority for upgrading on risks in priority watersheds and the ecological value of the riparian resources affected. Construct and maintain crossings to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.

Mine Alternative 2 and Transmission Line Alternative B. Mine Alternative 2 and Transmission Line Alternative B would not comply with RF-4. MMC would construct all new bridges on stream crossings to accommodate the 100-year flood, including associated bedload and debris. Crossings would be maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure. Culverts on the Bear Creek Road would be installed or extended as necessary. MMC's Plan of Operations did not address drainage features along the Libby Creek Road (NFS road #231) that would be used during the Libby Adit evaluation program, and while the Bear Creek Road was being reconstructed. On roads for the transmission line, MMC anticipates that no drainage would be provided, but would follow the agencies' guidance if installation of culverts were required.

Mine Alternatives 3 and 4, and Transmission Line Alternatives C, D, and E. Mine Alternatives 3 and 4, Transmission Line Alternatives C, D, and E would comply with RF-4. In mine Alternatives 3 and 4, compliance with RF-3 would be the same as Alternative 2 except as follows. Along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231), culverts that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows. The development and implementation of a final Road Management Plan in mine Alternatives 3 and 4, and transmission line Alternatives C, D, and E, would include a mitigation plan for road failures at stream crossings. For transmission line roads, culverts on roads would be installed on any stream where channel scour was present, if a culvert were not already in place. Culverts would be sized generally to convey the 100-year storm, but culvert sizing would be determined on a case-by-case basis with the lead agencies' approval of final sizing. When transmission line roads were placed into intermittent stored status, culverts would remain in place unless determined by the KNF to be high-risk for blockage or failure. All culverts would be removed when roads were decommissioned.

Road Management (RF-5)

Standard
Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams.

All Action Alternatives. Compliance in all alternatives with RF-5 would be the same as RF-4 (see previous discussion).

Minerals Management (MM-1)

Standard
Minimize adverse effects to inland native fish species from mineral operations. If a Notice of Intent indicates that a mineral operation would be located in a Riparian Habitat Conservation Area, consider the effects of the activity on inland native fish in the determination of significant surface disturbance pursuant to 36 CFR 228.4. For operations in a Riparian Habitat Conservation Area ensure operators take all practicable measures to maintain, protect, and rehabilitate fish and wildlife habitat which may be affected by the operations. When bonding is required, consider (in the estimation of bond amount) the cost of stabilizing, rehabilitating, and reclaiming the area of operations.

All Action Alternatives. All mine alternatives would have facilities located in RHCAs. This EIS considers the effects of all alternatives on inland native fish in the determination of significant surface disturbance pursuant to 36 CFR 228.4. The KNF would share responsibility with the DEQ to monitor and inspect the Montanore Project, and has authority to approve a Plan of Operations that includes all the necessary modifications to ensure that impacts to surface resources would be minimized. These modifications are incorporated into mine Alternatives 3 and 4, and transmission line Alternatives C, D, and E. The KNF and the DEQ would collect a reclamation bond from MMC to ensure that the lands involved with the mining operation are properly reclaimed. The joint reclamation bond would be held by the DEQ to ensure compliance with the reclamation plan associated with the DEQ Operating Permit and the Plan of Operations. The KNF may require an additional bond if it determined that the bond held by the DEQ was not adequate to reclaim National Forest System lands or was administratively unavailable to meet KNF requirements. The KNF and the DEQ would collect a reclamation bond for National Forest System lands affected by the transmission line; the DEQ would collect a reclamation bond for private lands affected by the transmission line.

Minerals Management (MM-2)

Standard
Locate structures, support facilities, and roads outside Riparian Habitat Conservation Areas. Where no alternative to siting facilities in Riparian Habitat Conservation Areas exists, locate and construct the facilities in ways that avoid impacts to Riparian Habitat Conservation Areas and streams and adverse effects on inland native fish. Where no alternative to road construction exists, keep roads to the minimum necessary for the approved mineral activity. Close, obliterate and revegetate roads no longer required for mineral or land management activities.

Mine Alternative 2 and Transmission Line Alternative B. MMC's Alternative 2 and Alternative B would not comply with MM-2. The Ramsey Plant Site would be located in a RHCA. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. The disturbance areas for LAD Area 2 would disturb the RHCA along Ramsey Creek. The lead agencies identified that modification to the LAD Area 2 disturbance area, proposed in mine Alternatives 3 and 4, is a practicable alternative to the LAD Area 2 as proposed in Alternative 2. No alternative to road construction in RHCAs was identified for roads associated with the mine facilities. In all mine alternatives, road construction in RHCAs would be kept the minimum necessary for the approved mineral activity. MMC's Alternative B would locate roads and transmission line structures in RHCAs. The lead agencies' modifications to MMC's proposed alignment and structure placement incorporated into Alternative C, which would reduce the number of roads and transmission line structures in

RHCAs, is a practicable alternative. In Alternative 2 and Alternative B, MMC would close, obliterate and revegetate roads no longer required for mineral or land management activities.

Mine Alternatives 3 and 4, and Transmission Line Alternative C, D, and E. These alternatives incorporate modifications and mitigations to MMC's proposals that are alternatives to siting facilities in RHCAs. These alternatives would reduce the number of facilities located in RHCAs. No alternatives exist that eliminate the need to site facilities in RHCAs. These alternatives would minimize effects on RHCAs and inland native fish. Roads no longer required for mineral or land management activities would be placed into intermittent stored service or decommissioned (see INFS standard RF-3).

Minerals Management (MM-3)

Standard
Prohibit solid and sanitary waste facilities in Riparian Habitat Conservation Areas. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in Riparian Habitat Conservation Areas exists, and releases can be prevented and stability can be ensured, then:

a. analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics.

b. locate and design the waste facilities using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, prohibit such facilities in Riparian Habitat Conservation Areas.

c. monitor waste and waste facilities to confirm predictions of chemical and physical stability, and make adjustments to operations as needed to avoid adverse effects to inland native fish and to attain Riparian Management Objectives.

d. reclaim and monitor waste facilities to assure chemical and physical stability and revegetation to avoid adverse effects to inland native fish, and to attain the Riparian Management Objectives.

e. require reclamation bonds adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities.

Mine Alternatives-Plant Site. The Ramsey Plant Site in Alternative 2 would not comply with MM-3. The Ramsey Plant Site would be located in a RHCA and would be constructed with waste rock. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. Preliminary evaluation indicates the Libby Plant Site could be built of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction.

Mine Alternatives-Tailings Impoundment. The tailings impoundment in all mine alternatives would comply with MM-3. Section 2.13.2.4, *Tailings Impoundment* discusses the lead agencies' analysis of alternative tailings disposal methods and locations. Compliance with INFS was a key criterion in the alternatives analysis. The lead agencies developed Alternatives 3 and 4 to minimize the extent to which RHCAs would be affected. Alternatives that would eliminate all effects to RHCAs were not practicable.

The waste material (tailings) has been analyzed using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics. The waste analysis results are discussed in section 3.8, *Geology*. In Alternative 2, during operations MMC would collect representative rock samples from the adits; ore zones; above, below, and between the ore zones; and tailings for static and kinetic testing. In Alternatives 3 and 4, MMC also would collect samples of the lead barren zone, mineralized alteration haloes within the lower Revett, and portions of the Burke and Wallace Formations for static and kinetic testing; assess potential for trace metal release from waste rock; and conduct operational verification sampling within the Prichard Formation during development of the new adits.

Potential acid-generating materials would be segregated for special handling as they were mined and would be placed under sufficient cover to minimize direct exposure to the atmosphere and precipitation. Such locations could include the inner portions of the tailings dam and inside the mine workings. No rock material would be used for construction before determination of its acid-producing potential. In addition, waste rock generated from the underground barren zone would be minimized, to the extent possible, due to higher lead concentrations present in this rock zone, and the greater potential for acid generation. Barren zone waste rock would be segregated from other waste rock and disposed underground.

All waste rock data would be evaluated with water quality monitoring data to determine whether any changes in water quality were the result of acid or sulfate production. Annual reports documenting sample location, sample methods, detection limits, and testing results would be submitted to the lead agencies. Acid-base accounting results would be correlated with lithology and total sulfur analyses.

The tailings impoundment in all mine alternatives would be located and designed using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. Acid generation of the tailings would be unlikely, but tests of metal mobility and monitoring at the Troy Mine suggest that some metals would be mobile in tailings effluent at a near-neutral pH.

Seepage from the impoundment would be minimized by a seepage collection system. In the 1992 and 1993 RODs and the DEQ Operating Permit #00150, the lead agencies required Noranda to modify the impoundment design to minimize seepage from the tailings impoundment to the underlying ground water. As this section discusses, MMC incorporated this requirement into the current tailings impoundment design. A seepage collection system would collect seepage from in and around the tailings impoundment. The collection system would consist of a Seepage Collection Dam and Pond, underdrains beneath the dams and impoundment, blanket drains beneath the dams, and a high-density, polyethylene (HDPE) geomembrane liner beneath portions of the tailings impoundment area (Figure 8 and Figure 9). Pumpback wells would be used, if necessary, to collect tailings impoundment seepage that reached ground water.

MMC has addressed the stability of the tailings impoundment dams through a series of minimum allowable safety factors against failure for static and dynamic loading conditions of the facilities (Klohn Crippen 2005). The factors of safety (FOS) for stability are summarized in section 3.9, *Geotechnical Engineering*. MMC's design criteria are industry design standards for dam design and construction and have been established as measures of certainty for the design of safe earth and rock fill dams.

MMC's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Specific objectives are: 1) long-term site stability, 2) protection of surface and ground water, 3) establishment of a self-sustaining native plant community where applicable and possible, 4) wildlife habitat enhancement, 5) protection of the public health and safety, and 6) attaining post-mining land use. The reclamation plan would be revised periodically to incorporate new reclamation techniques and update bond calculations. Prior to temporary or final closure, MMC would submit a revised reclamation plan to the lead agencies for approval.

MMC expects all stockpiled waste rock to be used in various construction activities. It is anticipated that no waste rock would remain at the LAD Area 1 stockpile after cessation of mining operations. Soil removed from this area prior to its use would be replaced and the area revegetated. Waste rock characterization testing would be conducted during mine operations in the event that unanticipated modifications to the reclamation plan were required.

The KNF and the DEQ would require a reclamation bond adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities (see discussion of INFS standard MM-1).

Minerals Management (MM-6)

Standard
Develop inspection, monitoring, and reporting requirements for mineral activities. Evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of Riparian Management Objectives and avoid adverse effects on inland native fish.

All Action Alternatives. All action alternatives would comply with MM-6. In Alternative 2 and Alternative B, MMC would follow all inspection, monitoring, and reporting requirements for mineral activities developed by the agencies. MMC would evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of RMOs and avoid adverse effects on inland native fish. In the other action alternatives, the lead agencies have modified the monitoring and reporting requirements to better assess the effects of the proposed project.

Lands (LH-3)

Standard
Issue leases, permits, rights-of-way, and easements to avoid effects that would retard or prevent attainment of the Riparian Management Objectives and avoid adverse effects on inland native fish. Where the authority to do so was retained, adjust existing leases, permits, rights-of-way, and easements to eliminate effects that would retard or prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. If adjustments are not effective, eliminate the activity. Where the authority to adjust was not retained, negotiate to make changes in existing leases, permits, rights-of-way, and easements to eliminate effects that would prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. Priority for modifying existing leases, permits, rights-of-way, and easements would be based on the current and potential adverse effects on inland native fish and the ecological value of the riparian resources affected.

All Transmission Line Alternatives. All transmission line alternatives would comply with LH-3. The KNF issuance of any permit or approval associated with the Montanore Project would avoid effects that would retard or prevent attainment of the RMOs and avoid adverse effects on inland native fish.

Alternative B. Alternative B would comply with LH-3. Compliance with LH-3 would be achieved through minimizing vegetation clearing and adverse effects in RHCAs through the use of steel monopoles, which would require a clearing area up to 150 feet. Clearing associated with Alternative B would occur outside RHCAs, if possible. If clearing were necessary in an RHCA, effects would be minimized through use of appropriate BMPs.

Other Transmission Line Alternatives. The other transmission line alternatives would comply with LH-3. Structure type in Alternatives C, D, and E would be H-frame wooden poles (except for a short segment on Alternative E), which would require a clearing area up to 200 feet. Wooden H-frame structures generally allow for longer spans and require fewer structures and access roads in RHCAs. Structures would be installed using a helicopter to minimize road construction and vegetation clearing in RHCAs. Disturbance and vegetation clearing in RHCAs at stream crossings would be minimized through implementation of a Vegetation Clearing and Disposal Plan. As mitigation, MMC would leave large woody material for small mammals and other wildlife species within the cleared transmission line corridor on National Forest System lands.

General Riparian Area Management (RA-2)

Standard
Trees may be felled in Riparian Habitat Conservation Areas when they pose a safety risk. Keep felled trees on site when needed to meet woody debris objectives.

All Action Alternatives. Timber harvest in RHCAs in LAD Area 2 in Alternative 2 is discussed in the previous INFS standard TM-1. Trees cleared in RHCAs for the transmission line would be limited to those that pose a safety risk. Developing and implementing a Vegetation Removal and Disposition Plan, minimizing heavy equipment use in RHCAs (Environmental Specifications, Appendix D), and using helicopters for structure placement and vegetation clearing in Alternatives C, D, and E would minimize clearing and disturbance in RHCAs. Alternatives C, D, and E would comply with RA-2.

General Riparian Area Management (RA-3)

Standard
Apply herbicides, pesticides, and other toxicants, and other chemicals in a manner that does not retard or prevent attainment of Riparian Management Objectives and avoids adverse effects on inland native fish.

All Action Alternatives. All action alternatives would comply with RA-3. In Alternative 2 and Alternative B, measures outlined in MMC's Weed Control Plan approved by the Lincoln County Weed Control District would be followed during operations and reclamation. All herbicides used in the analysis area would be approved for use in the KNF, and would be applied according to the labeled rates and recommendations to ensure the protection of surface water, ecological integrity, and public health and safety. In the other action alternatives, MMC also would implement all weed BMPs identified in Appendix A of the KNF Invasive Plant Management Final EIS (KNF 2007) for all weed-control measures. These measures would ensure that herbicides, pesticides,

and other toxicants, and other chemicals were used in a manner that would not retard or prevent attainment of RMOs and would avoid adverse effects on inland native fish.

General Riparian Area Management (RA-4)

Standard
Prohibit storage of fuels and other toxicants within Riparian Habitat Conservation Areas. Prohibit refueling within Riparian Habitat Conservation Areas unless there are no other alternatives. Refueling sites within a Riparian Habitat Conservation Area must be approved by the Forest Service or Bureau of Land Management and have an approved spill containment plan.

Mine Alternatives. MMC's Alternative 2 would not comply with RA-4. Fuel storage at the Ramsey Plant Site would be about 150 feet from Ramsey Creek, within the Ramsey Creek RHCA. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. Fuel storage at the Libby Plant site would not be within a RCHA. MMC's Spill Response Plan provides a spill containment and response plan. Alternatives 3 and 4 would comply with RA-4.

Watershed and Habitat Restoration (WR-1)

Standard
Design and implement watershed restoration projects in a manner that promotes the long-term ecological integrity of ecosystems, conserves the genetic integrity of native species and contributes to attainment of Riparian Management Objectives.

All Action Alternatives. All action alternatives would comply with WR-1. The fisheries mitigation proposed in Alternative 2 was developed in 1993 during the permitting of the original Montanore Project, and does not focus on bull trout or designated bull trout critical habitat. RMOs were not in place in 1993. Mine Alternatives 3 and 4 propose instream rehabilitation and structures as mitigation to meet RMOs and improve conditions for native fish.

Fisheries and Wildlife Restoration (FW-1)

Standard
Design and implement watershed fish and wildlife habitat restoration and enhancement actions in a manner that contributes to attainment of the Riparian Management Objectives.

All Action Alternatives. The mitigation proposed in mine Alternatives 3 and 4 would comply with FW-1. About 43 miles of proposed access changes and either placing roads into intermittent stored service or decommissioning them would reduce sediment to area creeks and contribute to attainment of the RMOs.

3.6.4.12 Short- and Long-Term Effects

Short-term effects of construction and operation of the project in Alternative 2 would include potential increases in sedimentation within the Libby Creek drainage. Alternatives 3 and 4 are predicted to include fewer changes in sedimentation in the Libby Creek drainage. While all of the transmission line alternatives pose some risk of increased sedimentation in analysis area streams, Alternative C represent the lowest risk of sediment effects from the transmission line. The predicted change in sedimentation rates with these alternatives likely would have few, if any, effects on fish populations, and these effects would be short-term because annual snowmelt runoff can flush accumulated fine sediments downstream.

Long-term effects of the project would include a permanent loss of 13,000 feet of the pure redband habitat in Little Cherry Creek due to the construction of the tailings impoundment and diversion channel in Alternative 2, and a similar loss of habitat in Alternative 4. This loss of habitat would adversely affect the pure redband trout population that currently exists in Little Cherry Creek. Although not specifically aimed at mitigation for pure redband trout populations, habitat improvement and mitigation measures included (in varying extent) in Alternatives 2, 3, and 4 would result in restoration of stream habitat and recreational access lost due to the development of the diversion channel and other mine facilities.

Water quality in the analysis area would improve over time during operations, but may not return to pre-mine conditions and, if not, would continue to adversely affect the biotic communities due to:

- Water quality changes that may occur due to loss of a deep ground water supply to streams, springs, and lakes
- Water quantity changes in streams that would occur in Alternatives 2 and 4 due to the diversion of Little Cherry Creek

Decreases in flow in Libby Creek, Ramsey Creek, Rock Creek, and the East Fork Bull River are predicted to occur for all action alternatives during mine operations. After the mine void filled (about 70 years after mining), flow in these streams would increase compared to flow during operations, but may not return to pre-mine conditions. If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Flow changes may not be measurable or separable from natural flow variability, but any decrease in flow could have adverse long-term effects on the bull trout and westslope cutthroat trout populations in these streams by decreasing available habitat in the headwaters of these streams during certain times of the year. Bull trout may be particularly affected by these decreases because the habitat loss would occur during their spawning period. Additionally, the East Fork Bull River is considered one of the most important bull trout spawning streams in the lower Clark Fork River drainage. The Little Cherry Creek diversion would reduce the available habitat by 13,000 feet for the pure redband populations in Little Cherry Creek using Alternatives 2 and 4.

Habitat restoration efforts would be included in Alternatives 2, 3, and 4 and would provide mitigation for the loss of trout habitat in Little Cherry Creek by restoring portions of Libby Creek or other streams within the drainage.

3.6.4.13 Irretrievable and Irreversible Commitments

The Little Cherry Creek diversion would reduce available habitat by 13,000 feet for the small, pure redband population in Little Cherry Creek in Alternatives 2 and 4. The agencies' analysis assumed the engineered diversion channel would not provide any fish habitat, while the two channels would eventually provide marginal fish habitat for both redband trout and bull trout.

Alternatives 2 and 4 could result in an irreversible loss of genetic diversity from the redband trout found in Little Cherry Creek if efforts to collect fish from the affected segment of Little Cherry Creek to be transferred to the diversion drainage were not entirely successful. Additionally, the loss of habitat in Little Cherry Creek could result in a decrease in redband populations in that stream with these alternatives. Hybridization of the pure redband trout population in Little Cherry

Creek is unlikely to occur in Alternative 3, but may occur in Alternatives 2 and 4 if barriers did not develop in the diversion drainage as predicted and the redband trout come in contact with non-native trout in the Libby Creek drainage. Increased sedimentation within the Libby Creek drainage also could adversely affect redband and bull trout populations. Habitat restoration efforts would be included in Alternative 2, and to a greater extent in Alternatives 3 and 4, and would provide mitigation for the loss of trout habitat in Little Cherry Creek by restoring portions of Libby Creek or other streams within the drainage.

Adverse effects from increased sedimentation rates may occur to redband and bull trout populations and designated bull trout critical habitat with Alternative B. Sedimentation effects would be less with the other transmission line alternatives.

Alternatives 2, 3, and 4 could result in an irreversible reduction of bull trout and westslope cutthroat trout habitat in Rock Creek drainage due to decreases in flow. If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Loss of bull trout habitat in the East Fork Bull River in Alternative 2 could be detrimental to bull trout populations in the lower Clark Fork River because this stream is considered a primary spawning location in this system. The completion of the habitat inventory and construction of instream structures forming pools and deep water habitat would improve the bull trout habitat in the East Fork Bull River.

3.6.4.14 Unavoidable Adverse Environmental Effects

Based on the agencies' conceptual model of the connection of surface and ground water in the analysis area, mining of the ore body would unavoidably reduce streamflows and spring flows, and affect lake levels in surface water located above the ore body, but below an elevation of about 5,600 feet. Decreased base flow would result in the loss of aquatic habitat. Sediment loading to the analysis area streams would increase due to erosion from mine facility and transmission line construction.

3.7 Cultural Resources

3.7.1 Regulatory Framework

Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended (16 U.S.C. 470, *et seq.*) and its implementing regulations under 36 CFR 800 require all federal agencies to consider effects of federal actions on cultural resources eligible for or listed in the National Register of Historic Places (NRHP). Both listed and potentially eligible properties must be considered during Section 106 review. In the Section 106 Review, the Forest Service considers effects to cultural resource properties within the area of potential effect (APE). The APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist (36 CFR 800.16)."

Traditional cultural properties (TCPs) are protected under Section 106 of the NHPA; the American Indian Religious Freedom Act of 1978 (AIRFA); and the Native American Grave Protection and Repatriation Act of 1990 (NAGPRA). A TCP may be eligible for listing in the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in the history of the community or tribe and, (b) are important in maintaining the continuing cultural identity of the community or tribe. Effects on American Indians have been discussed in section 3.5, *American Indian Consultation.*

Generally, any site of human activity older than 50 years is considered to be a potential cultural resource. The NHPA requires federal agencies to identify any cultural resource properties that might be affected by a federal undertaking. An undertaking refers to any federal action, such as approval of a Plan of Operations for the Montanore Project. If the cultural resource is affiliated with American Indian use, then consultation with tribes who have cultural affiliation with the site begins. Once identified, a cultural resource property is formally evaluated by the KNF in consultation with the SHPO, to determine whether the property is eligible for listing on the NRHP.

After consultation, the SHPO provides a determination of eligibility for each cultural resource affected by the project. If the property is found to be eligible, the KNF will determine whether the property would be adversely affected by the undertaking. Cultural resources that remain eligible for listing in the NRHP and that cannot be avoided during project implementation would be considered adversely affected. When adverse effects are anticipated, MMC may choose to redesign the project to avoid the property. If avoidance is not feasible, actions will be taken to mitigate any adverse effects to the property. A mitigation plan will be developed by MMC, reviewed by the KNF, reviewed by culturally affiliated tribes, and approved by the SHPO and the Advisory Council on Historic Preservation.

The location of cultural resource sites is exempt from public disclosure under Public Law 94-456. 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. Similar state laws governing cultural resources are found in 22-3, MCA.

3.7.2 Analysis Area and Methods

The APE includes all mine-related facilities and four transmission line alternatives, each with a 500-foot buffer. The buffer areas are included in the analysis of direct, indirect, and cumulative effects. No formal consultation has taken place between the KNF and the SHPO regarding definition of the APE, but consultation is expected to take place prior to project implementation.

Cultural resources were identified within the APE using three methods:

- A Class I file and literature review with the SHPO and the KNF by Historical Research Associates (Historical Research Associates 2006a, 2006b) to identify previous cultural resource inventories and archaeological sites within the APE
- A Class III intensive pedestrian cultural resource inventory was conducted within all mine facility footprints, including portions of the APE that are on private land (Historical Research Associates 1989a, 1989b, 1989c, 1990, 2006a, 2006b)
- Shovel testing areas identified by the KNF as medium to high probability areas for cultural resources, in addition to pedestrian survey (Historical Research Associates 2006a, 2006b)

Mine facility areas proposed in Alternative 2 (*i.e.*, Little Cherry Creek Tailings Impoundment Site, LAD Areas 1 and 2, Ramsey Plant Site, and Libby Adit Site) were inventoried at an intensive level, including shovel testing in areas of low ground visibility (Historical Research Associates 2006a; 2006b. Previous inventory conducted for Noranda included portions of proposed facility locations (Historical Research Associates 1990). Once project engineering has been finalized, additional inventory would be required to satisfy Section 106 requirements. Of the transmission line alternatives, only segments of the North Miller Creek, Modified North Miller Creek, and Miller Creek Alternatives have been subject to intensive inventory (Historical Research Associates 1990; 2006b). Effects to cultural resources were evaluated using GIS spatial analysis to compare the location of cultural resources in relation to proposed project facilities. Because not all of the proposed transmission line alternatives were inventoried for cultural resources, only those cultural resources identified through the file and literature review were considered in the effect analysis. Once a final transmission line alignment has been chosen, any remaining pedestrian inventory and/or exploratory shovel testing would be conducted to comply with Section 106 of the NHPA and 22-3, MCA. If previously unknown cultural or historical resources were discovered during any remaining inventory, MMC would avoid disturbing the sites and their setting as recommended after consultation with SHPO and as allowed by the landowner.

3.7.3 Affected Environment

3.7.3.1 Cultural Resource Overview

The following cultural overview is summarized from a synthesis provided by Historical Research Associates (1989a; 1989b; 1990; 2006a; 2006b). At the time of Euro-American contact, two major ethnic groups occupied and used areas that include the current analysis area. The Kalispell or Lower Pend d'Oreille occupied the Clark Fork River drainage from the area around Lake Pend d'Oreille in Idaho to the vicinity of Plains, Montana. The Kootenai (also spelled Kutenai) occupied the area drained by the Kootenai River in Montana and the Kootenay and upper Columbia rivers in British Columbia. They occupied semi-permanent winter encampments and

seasonally exploited other sites. The Kootenai, who subsisted on a hunting-gathering economy based primarily on fish, big game and camas, have used the analysis area for the last three to five centuries.

The most salient prehistoric data come from the work conducted at the Libby Dam and Reservoir area. Work from this area established clear continuity between prehistoric use of the area and the historic Kootenai. The spatial extent of the Kootenai, and by extension most other groups in the region, was considerable due to seasonal mobility between the mountains and plains as a means of successful adaptation. It is likely that the Kootenai split into smaller groups early in the Common Era, each relying more heavily on either plains or mountain-based resources, depending on their location, while using extensive trade networks.

The first contact between Native Americans and Euro-Americans in the area was initiated by explorers and fur traders. The first Euro-Americans to enter the analysis area were LeGasse and LeBlanc, employees of the Northwest Company sent into the region in 1801. Jaco Finley crossed the Rocky Mountains via Howse Pass in 1806 and David Thompson arrived in the Libby area in May, 1808; his travels are described in journals dated 1808-1812. Several trading posts were established in the region and travel routes such as the “Kootenai Road” became important links to connect the Kootenai River region with the trading posts.

More permanent Euro-American settlements resulted from the influx of people during the gold strikes of the 1860s and the construction of the transcontinental railroads through the Clark Fork Valley in 1883 and the Kootenai Valley in 1892. There was placer mining and an established mining camp along Libby Creek by 1867-1868. The initial rush to Libby Creek included 500 to 600 men, but the number quickly diminished to a handful by early 1868. The camp was referred to as Libbysville. Little to no placer mining took place during 1876 to 1885 when a small rush resumed after gold was once again discovered. Settlement along the Kootenai River was limited to the town of Tobacco Plains until the late 1880s, when Old Town or Lake City was established near with the mouth of Ramsey Creek on upper Libby Creek. The Thompson Falls to Libby Creek Trail was extended to Old Town and a general store existed to supply goods. Old Town was abandoned in 1889 with the establishment of Old Libby, which in turn was abandoned in 1891 when the Howards, among others, established ranches near the mouth of Libby Creek in anticipation of the Great Northern Railroad route to be established closer to the Kootenai. Placer mining in the Libby Creek drainage peaked in the early 1900s. Both railroads and mining contributed to the development of the timber industry, which became the economic base in both Lincoln and Sanders counties.

A major change in the region resulted from the establishment of the Forest Reserves, later known as National Forests. Lands within the reserves came under the administration and protection of the federal government, and timber cutting became regulated. Portions of the land within the analysis area were included in the Cabinet Forest Reserve, now part of the Libby and Cabinet Ranger Districts of the KNF.

3.7.3.2 Archaeological Resource Potential

Based on sites recorded in the region, and a synthesis of expected cultural resources provided in the KNF Heritage Guidelines (KNF 2002), the following cultural resource types were considered most likely to occur in the analysis area: prehistoric campsites, scarred trees, historic cabins, trading posts, mining and logging sites, homesteads, bridges, and trash dumps. Cultural resources in upland areas are expected to be fewer than in lower elevation areas and along major water

courses. Upland areas were used seasonally by hunter-gatherer groups for specific economic procurement tasks and, as such, the cultural imprints from these activities are expected to be less visible than long-term habitation sites located at lower elevations (KNF 2002). Identification of specialized economic activity sites expected in upland areas is difficult because of the limited material assemblage associated with this type of site and the extensive vegetation cover of the analysis area. Subsurface testing was used in high-probability areas to locate cultural resources.

3.7.3.3 Recorded Cultural Resources

3.7.3.3.1 Mine Facilities

The file and literature review and inventory of mine related facilities determined that 20 cultural resources have been previously recorded within the APE (Table 69 and Table 70). Four potential resources are known but have not been formally recorded (North Fork of the Miller Creek Trail, the Libby Divide Trail, and site leads FS D5-241SL and D5-363). The two trails are considered significant resources under a 1997 Programmatic Memorandum of Agreement (PMOA) signed between the KNF, the SHPO, and the Advisory Council on Historic Preservation.

Known cultural resources in mine facility areas (Table 69) are six officially eligible sites, two field not eligible sites, one field eligible site, and one site that has not been evaluated. Most significant is site 24LN1323, the Libby Mining District (District), which encompasses most of the mine facility areas and the northwest terminus of the transmission line alternatives. This site is a NRHP eligible historic district that embodies the physical features of mining from 1867 to the 1950s and a visual aspect that conveys both setting and location criteria. Six of the sites are related to the District and are considered contributing elements of the District. Sites 24LN320, known as the Comet Placer, 24LN1677 (Beager Cabin), and 24LN1678 (unnamed cabin) are officially eligible for the NRHP as contributing elements to the District. Sites 24LN943 and 24LN980 are listed as not eligible as contributing elements of the District, and site 24LN1209, the Old Libby Wagon Road, is considered a contributing element to the District. Sites 24LN320 and 24LN1209 are located within the Little Cherry Creek Tailings Impoundment Site (Alternatives 2 and 4) and are officially eligible for the NRHP. Site 24LN943 is a historic logging camp originally recommended as not eligible, and has since been destroyed by previous construction associated with the Libby Adit (private property). Site 24LN1680 is believed to be a portion of a placer mine that extends about 100 feet into the Libby Adit facility. It is currently unknown what elements of this resource, if any, actually extend into the APE.

The KNF has identified an additional four cultural resources and two unrecorded sites that may be affected by proposed fishery mitigation work associated with Alternative 2. These include sites 24LN1677 and 24LN1678, both of which are contributing elements to the Libby Mining District (24LN1323); site 24LN2203, a prehistoric site with an unknown eligibility status; an unrecorded feature of 24LN980 (historic dam) that has an unresolved eligibility status; and site leads D5-241SL and D5-363 that require documentation and evaluation prior to project implementation.

Table 69. Known Cultural Resources within Mine Facility Areas.

Smithsonian Site #	Site Type	NRHP Eligibility	Area of Potential Effect
*24LN320	Historic mining features - Comet Placer	Officially Eligible	Little Cherry Creek Tailings Impoundment Alternatives 2 and 4
*24LN943	Logging camp	Field Not Eligible (destroyed)	Libby Adit All Alternatives
*24LN980	Dam	Field Not Eligible	Alternative 2 – Proposed Mitigation Area
*24LN1209	Historic road/trail – Libby Wagon Road	Officially Eligible	Little Cherry Creek Tailings Impoundment Alternatives 2 and 4
24LN1323	Libby Mining District	Officially Eligible	All project components except Libby Adit
*24LN1677	Beager Cabin	Officially Eligible	Alternative 2 – Proposed Mitigation Area
*24LN1678	Cabin	Officially Eligible	Alternative 2 – Proposed Mitigation Area
24LN1680	Placer Mine (linear)	Officially Eligible	Libby Adit (100 feet according to GIS) All Alternatives
24LN2203	Prehistoric	Field Eligible	Alternative 2 – Proposed Mitigation Area
FS D5-241SL	Mining features and cabin	Not Evaluated	Alternative 2 – Proposed Mitigation Area
FS D5-363	Mining camp	Not Evaluated	Alternative 2 – Proposed Mitigation Area

*Contributing cultural resources to the Libby Mining District (24LN1323).

3.7.3.3.2 Transmission Line Alignments

Known cultural resources located within the four transmission line corridor alternatives are listed in Table 70. Cultural resources common to all transmission line alternatives include 24LN208, 24LN722, 24LN1323 (Libby Mining District), and the Libby Divide and Miller Creek Trails. Site 24LN208 (Trail #6) crosses all alternatives north of the Sedlak Substation where the alignment parallels U.S. 2. Site 24LN722 was recorded within the area proposed for the Sedlak Substation, but was unable to be relocated by Historical Research Associates during recent inventory efforts. Historical Research Associates assumed the scarred tree that comprised this resource had been logged and no longer exists. The Libby Divide and North Fork of the Miller Creek Trail is a system of trails crossed by all transmission line alternatives except the West Fisher Alternative (Historical Research Associates 2006a, 2006b).

Site 24LN720 is a multi-component historic mining and prehistoric campsite located within the buffer area of Alternative E. The site is officially eligible for the NRHP. Site 24LN962 is the Teeter Peak Trail that crosses Alternatives D and E and is recommended field not eligible. Site

24LN963 is an unnamed historic road/trail that crosses Alternative E, which is also recommended field not eligible. Site 24LN1584 includes two culturally modified trees located within the buffer area of Alternative B. Similarly, site 24LN1585 includes four culturally modified trees within Alternatives B, C, and D. Both sites are recommended field eligible. Site 24LN1818 is a portion of U.S. 2 that crosses Alternatives B, C, and D. Because of the ongoing modification that the highway receives, the resource has not been evaluated for the NRHP.

Table 70. Cultural Resource Sites Located within the Transmission Line Alternatives.

Smithsonian Site #	Site Type	NRHP Eligibility	Area of Potential Effect
24LN208	Trail #6	Field Not Eligible	All Alternatives
24LN720	Historic Mining and Prehistoric campsite	Officially Eligible	Alternative E
24LN722	Scarred Tree	Undetermined (destroyed)	All Alternatives (Sedlak Substation area)
24LN962	Teeter Peak Trail	Field Not Eligible	Alternatives D and E
24LN963	Historic road/trail	Field Not Eligible	Alternative E
24LN1323	Libby Mining District	Officially Eligible	All Alternatives (no contributing elements affected)
24LN1584	Two scarred trees	Field Eligible	Alternative B
24LN1585	Four scarred trees	Field Eligible	Alternatives B, C, and D
24LN1818	Portions of U.S. 2	Not Evaluated	Alternatives B, C, and D
FS D5-122	North Fork Miller Creek Trail #505	Avoidance per 1997 PMOA	All Alternatives
FS D5-126	Libby Divide Trail #716	Avoidance per 1997 PMOA	All Alternatives

3.7.4 Environmental Consequences

3.7.4.1 Alternative 1 – No Mine

No direct, indirect, or cumulative effects would occur to cultural resources in Alternative 1. Natural weathering, deterioration, and vandalism of cultural resources would continue. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.7.4.2 Alternative 2 – MMC's Proposed Mine

All 11 cultural resources identified within mine facilities would be affected by Alternative 2 (Table 69) and remain potentially eligible for listing in the NRHP. Five of these resources may be impacted by proposed fishery mitigation areas and are discussed separately below. Site 24LN1323, the Libby Mining District, would be affected by all Alternative 2 facility components except construction of the Libby Adit site. The District includes an extensive area where placer

mining took place, including locations along drainages of Libby, Big Cherry, Midas, Bear, Poorman, Ramsey, Little Cherry, and Howard creeks. Mitigation would be necessary for those areas of the District that would be adversely affected by facility construction. Mitigation for the District could include formal documentation under the USDI National Park Service's Cultural Landscapes Program. The type of data recovery necessary for cultural landscapes would be determined from a data recovery plan developed in consultation with the KNF and the SHPO.

Site 24LN320 is located on private land within the Little Cherry Creek Tailings Impoundment Site and is individually officially eligible for the NRHP, as well as being a contributing element to the Historic District. The KNF recommends that additional recording is necessary in addition to potential data recovery efforts of known site components. Mitigation plans for sites 24LN320 and 24LN1209, also located within the Little Cherry Creek Tailings Impoundment Site, would need to be developed in consultation with the SHPO and could include Level II HAER documentation for site 24LN1209 and/or HABS documentation for site 24LN320 depending on the type of mining features present. Review and consultation with SHPO is required for site 24LN943 in order to receive a consensus determination of not eligible based on the loss of physical integrity of the site. Assuming concurrence from the SHPO, no additional work would be required. Additional fieldwork would be necessary for site 24LN1680 to determine what portion, if any, of this site actually extends into the footprint of the Libby Adit Site. If the site were found to extend into the Libby Adit facility footprint, a data recovery plan would need to be developed. Depending on the nature of the features that would be adversely affected, HAER documentation would be the likely mitigation.

Alternative 2 also includes proposed fishery mitigation work around Howard Lake and Libby Creek, which may have the potential to adversely affect five cultural resources. Trail paving associated with mitigation activities around Howard Lake has the potential to adversely affect site 24LN2203. The Forest Service has recommended that mitigation be implemented prior to ground disturbance, which could include either protective covering or data recovery. Rehabilitation efforts associated with Libby Creek have the potential to adversely affect three cultural resource sites (24LN980, 24LN1677, and 24LN1678) and two unrecorded sites (D5-241SL and D5-363). An unrecorded feature of 24LN980 would require documentation and evaluation as a potential contributing element of the District (24LN1323). The historic cabins officially eligible (24LN1677 and 24LN1678) would require HABS documentation if adversely affected by fishery mitigation activities. Review and consultation also would be required for site 24LN980 in order to receive a consensus determination of not eligible. This site also would need to be evaluated as to whether it contributes to the District. If the site were not eligible either individually or as a contributing element to the District, no additional work would be required. If the site were a contributing element to the District, a data recovery plan would need to be developed and could include HAER documentation. The two unrecorded sites (D5-241SL and D5-363) would need to be formally documented and evaluated for effects from the proposed mitigation activities. The KNF has recommended that sites 24LN980, 24LN1677, and 24LN1678, and the two unrecorded sites be considered for interpretation to benefit the public.

For those sites with unresolved eligibility status (24LN943, 24LN980, 24LN2203, D5-363, and D5-241SL), review and consultation with SHPO would be necessary prior to ground disturbing activities. For those cultural resources found to be eligible for listing in the NRHP following consultation, a data recovery plan would need to be developed in consultation between the Forest Service, the SHPO and, if necessary, the tribes. Finally, for those sites with consensus eligible determinations (24LN320, 24LN1209, 24LN1323, 24LN1677, and 24LN1678), data recovery

plans would need to be developed in consultation between the Forest Service, the SHPO and, if necessary, the tribes.

3.7.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Effects to cultural resource sites 24LN1323, 24LN1680, and 24LN943 are the same as described under Alternative 2. Alternative 3 would not directly affect any other cultural resources. Cultural resources in the analysis area 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.

3.7.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Effects to cultural resource sites 24LN320, 24LN943, 24LN1209, 24LN1323, and 24LN1680 are the same as described under Alternative 2. Alternative 4 would not directly affect any other cultural resources. Cultural resources in the analysis area 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.

3.7.4.5 Alternative A – No Transmission Line

No direct, indirect, or cumulative effects in the transmission line corridors would occur to cultural resources in Alternative A. Natural weathering, deterioration, and vandalism would continue.

3.7.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Eight cultural resources are located within the North Miller Creek Transmission Line (Alternative B) alignment and 500-foot buffer area (Table 70). Affected sites would be 24LN208, 24LN722, 24LN1323, 24LN1584, 24LN1585, 24LN1818, and Forest Trails 505 and 716. Effects to site 24LN1323 and potential mitigation efforts have been discussed under Alternative 2.

Site 24LN722 was once located within the proposed Sedlak Substation facility. Fieldwork determined that logging operations have removed the tree (Historical Research Associates 2006a). The North Miller Creek Alternative would cross site 24LN208 north of the Sedlak Substation location. Sites 24LN1584 and 24LN1585 are both culturally scarred tree locations within the 500-foot buffer area of the alignment; both have an eligibility status of field eligible. If the sites are determined eligible, they would be either avoided or a data recovery plan developed. Preliminary field review indicates they could be avoided by flagging and appropriate pole placement. Other trees would be preserved in the general location, if possible, to maintain integrity of setting and location. Site 24LN1818 remains unevaluated for the NRHP due to the ongoing modifications that the highway receives.

Although considered significant under the 1997 PMOA, Forest Trails 505 and 716 (the North Fork of the Miller Creek Trail and Libby Divide Trail, respectively) would be formally recorded and evaluated for the NRHP. If determined eligible, a plan would be necessary to mitigate adverse effects. If feasible, vegetation clearing for the transmission line would be conducted in a manner that maintains integrity of setting and location. Pole placement also would be designed to avoid or minimize effects on the trails.

Review and consultation with the SHPO would be necessary for sites 24LN722, 24LN208, 24LN1584, and 24LN1585 in order to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary to complete evaluation prior to SHPO consultation. Because effects would entail crossing of an overhead transmission line with no direct effects, a determination of no adverse effect may be achieved through consultation. For those cultural resources determined to be ineligible for the NRHP, no additional work would be necessary.

3.7.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN1323, 24LN1585, and 24LN1818, and Forest Trails 505 and 716 and proposed mitigation would be the same as described under Alternative B.

3.7.4.8 Alternative D – Miller Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN1323, and 24LN1585 and proposed mitigation would be the same as described under Alternative B. Alternative D would cross the Teeter Peak Trail (24LN962), which has an unresolved eligibility status of not eligible. Review and consultation with the SHPO would be necessary to receive a consensus determination prior to project implementation.

3.7.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, and 24LN1323 and proposed mitigation would be the same as described under Alternative B. Alternative E would cross both the Teeter Peak Trail (24LN962) described under Alternative D and an unnamed historic road/trail (24LN963) that has an unresolved eligibility status of not eligible. If Alternative E were selected, both sites 24LN962 and 24LN963 would be reviewed by the SHPO in order to receive a consensus determination. Site 24LN720 is multi-component historic mining and prehistoric campsite that is officially eligible for the NRHP. It was not included in Historical Research Associates' file and literature review because it was not under consideration as an alternative at the time of Historical Research Associates' review. Direct effects to this site may be avoided by proper pole placement and a protective cover of vegetation to maintain integrity of setting.

3.7.4.10 Summary of Effects

The effects of the mine alternative are summarized in Table 71; Table 72 summarizes the effects of the transmission line alternatives. The number of cultural resources affected under each alternative is:

- Alternative 2—10 cultural resources
- Alternative 3—3 cultural resources
- Alternative 4—5 cultural resources
- Alternative B—8 cultural resources
- Alternative C—7 cultural resources
- Alternative D—8 cultural resources
- Alternative E—8 cultural resources

Table 71. Summary of Effects of Mine Alternatives on Cultural Resources within the Area of Potential Effect and Potential Mitigation.

Site	Alternative	Type	NRHP Status	SHPO Consultation Necessary	Potential Mitigation
24LN320†	Mine Alternatives 2 and 4	Historic Mining features - Comet Placer	Officially Eligible	No	HABS/HAER
24LN943†	All mine action alternatives	Logging Camp	Field Not Eligible (destroyed)	Yes	No Further Work
24LN980†	Mine Alternative 2	Dam	Field Not Eligible	Yes	Pending Consultation
24LN1209	Mine Alternatives 2 and 4	Historic road/trail –Libby Wagon Road	Officially Eligible	No	HAER
24LN1323	All mine action alternatives	Libby Mining District	Officially Eligible	No	NPS Cultural Landscapes Program
*24LN1677	Mine Alternative 2	Beager Cabin	Officially Eligible	No	HABS
*24LN1678	Mine Alternative 2	Cabin	Officially Eligible	No	HABS
24LN1680	All mine action alternatives	Placer Mine (linear)	Officially Eligible	No	HAER
24LN2203	Mine Alternative 2	Prehistoric	Field Eligible	Yes	Protective Covering or Data Recovery (excavation)
FS D5-241SL	Mine Alternative 2	Mining features and cabin	Not Evaluated	Yes	Pending Consultation

Table 72. Summary of Effects of Transmission Alternatives on Cultural Resources within the Area of Potential Effect and Potential Mitigation.

Site	Alternative	Type	NRHP Status	SHPO Consultation Necessary	Potential Mitigation
24LN1323	All transmission line alternatives	Libby Mining District	Officially Eligible	No – eligibility Yes – mitigation plan	NPS Cultural Landscapes Program
24LN208	All transmission line action alternatives	Trail #6	Field Not Eligible	Yes – concurrence	No Further Work
24LN720	Transmission Alternative E	Historic Mining and Prehistoric campsite	Officially Eligible	No – eligibility Yes – mitigation plan	Avoidance (HABS/HAER and/or Data Recovery (excavation))
24LN722	All transmission line action alternatives	Scarred Tree	Undetermined	Yes – eligibility	Avoidance (Pending Consultation)
24LN962	Transmission line Alternatives D and E	Teeter Peak Trail	Field Not Eligible	Yes – concurrence	No Further Work
24LN963	Transmission Alternative E	Historic road/trail	Field Not Eligible	Yes – concurrence	No Further Work
24LN1584	Transmission Alternative B	Two scarred trees	Field Eligible	Yes – concurrence and mitigation plan	Avoidance
24LN1585	Transmission Alternatives B, C, and D	Four scarred trees	Field Eligible	Yes – concurrence and mitigation plan	Avoidance
24LN1818	Transmission Alternatives B, C, and D	Portions of U.S. 2	Not Evaluated	Yes – eligibility	Pending Consultation
FS D5-122	All transmission line action alternatives	North Fork Miller Creek Trail #505	Avoidance per 1997 PMOA	Yes – eligibility and mitigation plan	Pending Consultation
FS D5-126	All transmission line action alternatives	Libby Divide Trail #716	Avoidance per 1997 PMOA	Yes – eligibiltiy and mitigation plan	Pending Consultation

[†]Associated with the Libby Mining District.

3.7.4.11 Indirect Effects Common to All Alternatives

Indirect effects to cultural resources are possible from the increased access to the KNF that would result from the improvement and new construction of access roads. Effects would be more pronounced to visible historic properties such as mining or homesteading related cultural resources. Access would likely increase after closure of the mine and would result from recreational activities. Specific effects to cultural resources could include the illegal collection of artifacts and vandalism to standing structures or features.

3.7.5 Mitigation

All mine and transmission line alternatives would require additional cultural resource inventory to satisfy requirements of Section 106 under the NHPA and 22-3, MCA. The number of cultural resources that would require mitigation may increase pending the results of these additional inventory efforts. The appropriate type of mitigation is dependent on the nature of the cultural resource involved and is ultimately determined during consultation between MMC, the KNF, and the SHPO.

Mitigation could include data recovery (excavation) of prehistoric archaeological sites, a HABS for standing structures, or HAER for built resources such as mines, roads, and trails. For landscape-level resources such as the Libby Mining District, the USDI National Park Service's (NPS) Cultural Landscapes Program would be implemented. Mitigation also would include monitoring during ground disturbing activities when the subsurface spatial extent of the resource is unknown or because of the fragility of the resource and its proximity to the activity.

Any mitigation plan would be developed by MMC and approved by both the KNF and the SHPO under a memorandum of agreement (MOA), and would include consulting American Indian tribes if affected cultural resources were prehistoric or of recent cultural significance.

3.7.5.1 Mine Alternatives

3.7.5.1.1 Alternative 2 – MMC's Proposed Mine

Under Alternative 2, nine cultural resources would require mitigation. The largest of these is the Libby Mining District (24LN1323), which encompasses a large geographic area. Six other cultural resources contribute to the District. These include the Comet Placer (24LN320), an unnamed logging camp (24LN943), a dam (24LN980), the Libby Wagon Road (24LN1209), the Beager Cabin (24LN1677), and an unnamed cabin (24LN1678). Although two of the sites are not eligible for the NRHP (24LN943 and 24LN980) they may contribute to the overall significance of the District. The most appropriate mitigation would be to generate a Cultural Landscape Report under the USDI National Park Service's Cultural Landscapes Program. This report would document the history, significance, and treatment of the Libby Mining District as it currently exists within its bounded landscape. Individually, the remaining historic sites would require either HABS or HAER documentation (24LN320, 24LN1209, 24LN1677, and 24LN1678), including one site that has not been related to the District (24LN1680), but would probably be found to be contributing through further archival research. Two known but unrecorded sites require formal documentation and evaluation (D5-241 and D5-363). If either site is found to be eligible for the NRHP, mitigation would require both HABS and HAER documentation and may be included within the Libby Mining District and the Cultural Landscape Report.

3.7.5.1.2 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Under Alternative 3, two cultural resources would require mitigation. These sites are the Libby Mining District (24LN1323) and the Placer Mine (24LN1680). Mitigation efforts are described in mine Alternative 2.

3.7.5.1.3 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Under Alternative 4, four cultural resources would require mitigation efforts. Two of the sites, the Libby Mining District and the Placer Mine, have been discussed above under Alternative 3. The other two cultural resources that would require mitigation are the Comet Placer (24LN320) and the Libby Wagon Road (24LN1209). Depending on the type of physical remains associated with the Comet Placer, mitigation would entail either a HAER or HABS treatment. Mining engineering would require a HAER and standing structures would require a HABS. The Libby Wagon Road would require a HAER.

3.7.5.2 Transmission Line Alternatives

3.7.5.2.1 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Under Alternative B, five to six cultural resources would require mitigation. Portions of U.S. 2 (24LN1818) affected by the alternative have not been evaluated for the NRHP. If found to be eligible for the NRHP, mitigation for U.S. 2 would entail HAER documentation. Mitigation for the Libby Mining District (24LN1323) is discussed above under Alternative 2. Two of the sites, 24LN1584 and 24LN1585 can be avoided during pole placement and vegetation clearing and would not require mitigation. In the event that they could not be avoided, mitigation would include extensive photographic documentation. The two trails located within this alternative (D5-122 and D5-126 can also be avoided during pole placement. Visual effects to the trails could not be avoided under this alternative.

3.7.5.2.2 Alternative C – Modified North Miller Creek Transmission Line Alternative

Under Alternative C, six cultural resources would require mitigation efforts. The Libby Mining District is discussed above under mine Alternative 3. The five remaining cultural resources include four scarred trees (24LN1585), a single scarred tree (24LN722), which requires consultation to determine eligibility, and three linear resources: potential portions of U.S. 2 (24LN1818), the North Fork of Miller Creek Trail #505 (D5-122), and the Libby Divide Trail #716 (D5-126), both of which require avoidance under a 1997 PMOA. Although pole placement would avoid these linear resources, their associated setting would be compromised by development and would likely require a HAER in each instance. The single scarred tree and U.S. 2 would require consultation to determine eligibility.

3.7.5.2.3 Alternative D – Miller Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN1323, and 24LN1585 and proposed mitigation would be the same as described under Alternative B. Alternative D would cross the Teeter Peak Trail (24LN962), which has an unresolved eligibility status of not eligible. Review and consultation with the SHPO would be necessary to receive a consensus determination prior to project implementation.

Under Alternative D, all six cultural resources discussed above under Alternative C would require mitigation efforts. Potential mitigation efforts also would be the same as discussed under Alternative C.

3.7.5.2.4 Alternative E – West Fisher Creek Transmission Line Alternative

Under Alternative E, five cultural resources would require mitigation efforts. Sites 24LN1323 and 24LN722 and site leads D5-122 and D5-126 have been discussed above under Alternative C. The alternative also would affect a multi-component historic mining and prehistoric site (24LN720). If unavoidable, the mining portion of the site would require either HAER and/or HABS treatment and the prehistoric component would require data recovery (excavation).

3.7.5.3 Cumulative Effects

Past action, such as road building and timber harvest, may have affected cultural resources. Cultural resources affected by past actions after the passage of the NHPA in 1996 were mitigated in accordance with approved mitigation plans. The Miller-West Fisher Vegetation Management Project, which includes commercial timber harvest, trail construction, and other activities, could result in incremental cumulative effects to cultural resources within the APE for the Montanore Mine. Identified adverse effects to cultural resources from the Miller-West Fisher Vegetation Management Project would be addressed as part of a separate mitigation plan. No other reasonably foreseeable actions would have a cumulative effect with the Montanore Project.

3.7.5.4 Regulatory/Forest Plan Consistency

Following the identification of cultural resources, mitigation, and consultation, all alternatives would be in compliance with the KFP and all applicable federal regulations concerning cultural resources.

3.7.5.5 Irreversible and Irretrievable Commitments

Regardless of mine facility alternative or transmission line alternative, project implementation would require the irreversible commitment of portions of the Libby Mining District (24LN1323) and possibly a portion of 24LN1680. Five, and possibly six, NRHP eligible cultural resources would require irreversible commitments under Alternative 2: 24LN320, 24LN1209, 24LN1677, 24LN1678, 24LN2203, and possibly unrecorded site D5-241SL. Each of these sites would be destroyed following mitigation by the construction of mining related facilities. Their loss would be irreversible. Mitigation would serve to preserve these cultural resources in perpetuity through documentation. Pending consultation, an additional non-significant cultural resource would require irreversible commitments (24LN980). Aside from 24LN1323 and 24LN1680, no additional cultural resources would require an irreversible commitment. Alternative 4 would require irreversible commitments to sites 24LN320 and 24LN1209, in addition to sites 24LN1323 and 24LN1680.

3.7.5.6 Short-term Uses and Long-term Productivity

Because cultural resources are non-renewable, the short-term use of the area for project implementation has the potential for permanent impacts as discussed above under Alternative 2.

3.7.5.7 Unavoidable Adverse Environmental Effects

Unavoidable effects to cultural resources would be mitigated through the development of data recovery plans devised in consultation with the KNF, the SHPO and, if necessary, American Indian tribes.

3.8 Geology

Geology is the primary framework for most other resources discussed in the EIS. The geology controls the location of the mineral deposit to be mined, proposed mining techniques, environmental geochemistry, distribution of ground water in the subsurface, topography and, to some extent, the type of vegetation, and runoff of precipitation.

3.8.1 Analysis Area and Methods

The analysis and description of the geology of the proposed mine, tailings impoundment areas, and transmission line alternatives presented in this section are based on the 1992 Final EIS (USDA Forest Service *et al.* 1992) and subsequent descriptions provided by MMC. Because the geology typically does not change within human time scales, the previous analysis and descriptions in the 1992 Final EIS remain valid. No known studies would change the fundamental descriptions of the area. Elements of the geology that directly affect environmental geochemistry are emphasized within this description.

An environmental geochemical assessment of the waste and ore exposed in underground workings, tailings, and waste rock brought to the surface was conducted to evaluate the potential impact of discharge from mine facilities on downgradient surface and ground water quality. The specific geochemical issues of interest are acid generation and the potential release of metals and metalloids, regardless of acid production. The leaching of nitrate from blasting residues on ore, waste rock, and tailings is also a short-term concern. Factors of concern in predicting long-term environmental chemistry are therefore the occurrence and relative concentrations of metal and sulfide-bearing minerals (including non-acid generating sulfides), as well as their mode of occurrence (*i.e.*, in veins, on fractures or encapsulated within quartzite) and proposed management practices (*i.e.*, blasting, ore processing, and material placement) in terms of potential exposure to water and air.

A discussion of the geochemical methods used to predict trace element release and acid generation in the environment is provided at the start of section 3.8.3, *Environmental Consequences* below.

3.8.2 Affected Environment

3.8.2.1 Geologic Setting

3.8.2.1.1 Physiography

The Cabinet Mountains are bounded on the south by the Clark Fork River, on the east by Libby Creek, on the north by the Kootenai River, and on the west by the Purcell Trench in Idaho. The Bull River/Lake Creek valley separates the mountain range into east and west segments. The analysis area is in the southeast portion of the Cabinet Mountains and the portions of the Fisher River watershed between the Cabinet Mountains and Salish Mountains east of Libby. The Cabinet Mountains are a northwest-trending mountain range of rugged relief. The maximum relief in the analysis area is about 5,000 feet. The highest elevation in the vicinity is Elephant Peak at an elevation of 7,938 feet. The lowest elevations are 3,200 feet along Libby Creek and 2,900 feet along the Fisher River. The proposed plant site in Ramsey Creek is at an elevation of 4,400 feet; the elevation of the proposed tailings impoundment in Little Cherry Creek is at about 3,500 feet; and the elevation of the proposed Sedlak Park Substation is at 3,000 feet.

Area topography (Figure 42) is a function of the underlying rock types, structure (faults and folds), and geologic history. Slopes are generally steep (more than 30 percent) except along streams and rivers. Rocks in the area are relatively strong and not easily erodible. Most of them weather into small, thinly laminated fragments that form a colluvial (transported by gravity) mantle overlying bedrock. The talus slopes and hogback ridges are usually formed by the more weather resistant quartzite and limestone rocks.

Large faults bound the Cabinet Mountains on the east, south, and west. These faults are at least partly responsible for the formation of the valleys surrounding the Cabinet Mountains. The Clark Fork River, Libby Creek, Bull River-Lake Creek, and the West Fork Rock Creek valleys are all located along faults. A number of smaller streams in the analysis area also may be located along fault and fracture structures. The major land-forming features were created by the Rocky Mountain uplift and subsequent faulting. Topography in the analysis area has been influenced by Pleistocene-age glaciation (2 million to 10,000 years ago). In the northern part of the analysis area, Pleistocene alpine glaciers carved the landscape into a series of glacial features characterized by nearly vertical cliffs, ledges, steep colluvial slopes, and talus fields. The high peaks of the area (St. Paul, Rock, and Elephant peaks) are glacial horns formed by the headward erosion of the glaciers. Small- to moderate-sized lakes (tarns), such as Copper and Cliff lakes, have formed in the glacial cirque basins.

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

Higher elevation creeks generally flow through relatively narrow canyons and then spill into wider valleys at the periphery of the wilderness area. The wider valleys have flat to rolling bottoms, with lakebed and stream deposits capping and surrounding shallow to exposed bedrock.

3.8.2.1.2 Regional Geology

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

The Belt Supergroup can be divided into four major conformable groups. In ascending order, these are the Lower Belt, Ravalli Group, Middle Belt carbonate (Table 73), and the Missoula Group (not shown in Table 73). Regionally, the Lower Belt is represented by the Prichard Formation. The Prichard Formation consists mostly of argillites, with some interbedded siltite and quartzite units. It is the lowest formation within the Belt Supergroup in this area and is mapped as the thickest at 25,000 feet.

Table 73. Stratigraphy of Montanore Analysis Area.

Supergroup	Group	Formation	Member
Belt	Middle Belt Carbonate	Wallace	Upper Middle Lower
	Ravalli	Empire / St.Regis	
		Revett	Upper See detail belov Middle Lower (ore zone)
		Burke	—
	Lower Belt	Prichard	Transition Upper Lower

Formation	Member	Bed	Deposit
Revett	Upper	Upper quartzite Upper siltite Middle quartzite Lower siltite Lower quartzite	Troy
			Troy
	Middle		
	Lower	A	Rock Creek-Montanore
		B	
		C	
		D	
		E	
		F	
		G	Troy
		H	
		I	

Source: Boleneus *et al.* 2005.

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

The Middle Belt carbonate is separated into a western and eastern facies. The western facies Wallace Formation contains a conspicuous clastic component (but still contains a considerable proportion of carbonate material) and was deposited from a southern source terrain; the eastern

facies Helena Formation is largely a carbonate bank deposited along the Canadian Shield (USDA Forest Service and DEQ 2001). The two Formations interfinger or overlap along a broad zone that extends from Missoula northwest toward the Canadian border just east of Libby, Montana (Harrison 1972).

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

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

Quaternary age deposits are reflected in Pleistocene glacial erosion and deposition of stratified and unstratified sediments. Large areas are covered by glaciofluvial and glaciolacustrine sediments to depths up to several hundred feet. Near Libby, Montana, bluffs of glaciolacustrine silts stand up to 200 feet above the recent floodplain. Glaciolacustrine silts and clays prone to sloughing from road cuts are found at elevations between 2,900 and 4,000 feet in the two tailings impoundment areas, along the Fisher River, and along lower Miller and West Fisher creeks. During recent times, this and older materials have been eroded and reworked by stream activity.

There appear to have been three mineralizing events in the Belt rocks of this area. Most recently, Cretaceous to early Tertiary age granodiorite and quartz monzonite plutons intruded the highly folded and faulted Belt rocks in the central and northern portions of the Cabinet Mountains. This produced the mineralization of the prospects found along the eastern and southern flanks of the Cabinet Mountains. An older event involved the Precambrian age intrusions of igneous rock high in iron and magnesium that intruded the Wallace, Burke and Prichard Formations. The Purcell Lava is an example of such an event, which created the vein-hosted deposits found in the Ten Lakes area northeast of the Cabinet Mountains. The oldest mineralizing event is the Precambrian age migration of solutions through selected Formations within the Belt Supergroup, especially the Revett Formation, prior to or during lithification (Clark 1971; Hayes 1983; Lange and Sherry 1983).

The western Montana copper belt, first named by Harrison in 1972, hosts several large strata-bound Revett-style copper-silver deposits in permeable quartzite beds of the Revett Formation (Boleneus *et al.* 2005). Several Revett-style deposits, which occur in the upper and lower members of the Revett Formation, have been intensively studied by numerous investigators (Clark 1971; Harrison 1972; Hayes 1983; Lange and Sherry 1983; Bennett 1984; Hayes and Einaudi 1986; Hayes and Einaudi 1990). The world-class Rock Creek-Montanore deposit, currently under permitting review as two separate mining operations, and the Troy Mine (Spar Lake deposit) are each hosted in the Revett Formation. The Rock Creek portion of the deposit is separated from the Montanore (Rock Lake) portion by the Rock Lake fault. This document

follows the USGS nomenclature, which distinguishes the Rock Creek-Montanore deposit from the Troy deposit, as described by Boleneus *et al.* (2005). In cases where data have been collected solely from the Rock Creek or the Montanore portion of the Rock Creek-Montanore deposit, the term sub-deposit has been used.

Ore-grade stratabound copper-silver deposits in the Revett Formation are concentrated along a pre-mineralization pyrite-hematite interface, in relatively coarse-grained quartzite that acted as a paleoaquifer for ore-forming fluids. These deposits are characterized by pronounced zonation based on alteration-mineral assemblages, with ore typically occurring between the chalcopyrite-ankerite and pyrite-calcite zones. Mineralization is consistent throughout the Belt basin, with minor variations between defined deposits resulting from subtle variations in the stratigraphy of the interbedded quartzite, siltite, and argillites that comprise the Revett Formation. Boleneus *et al.* (2005) provide a comprehensive summary of this district and style of mineralization.

3.8.2.1.3 Geology of Analysis Area

Mine Area

Table 73 presents general stratigraphy for the analysis area, and Figure 57 is a bedrock geology map for the portion of the CMW area that overlies the sub-deposit at Montanore. The Prichard Formation is the oldest unit at Montanore and consists primarily of quartzite, with argillite, siltite, and mudstone. The Burke, St. Regis, and Empire Formations of the Ravalli Group are predominantly siltite, argillite, and quartzite. The Revett Formation, also of the Ravalli Group, is subdivided into three members based on the amount of quartzite, silty quartzite, and siltite. The Rock Creek-Montanore, stratabound copper and silver deposit is found in the A-D quartzite beds in the uppermost portion of the lower member of the Revett Formation, which consists primarily of quartzite and layers of siltite and silty quartzite. The Wallace Formation is the younger Middle Belt Carbonate group of rocks in the analysis area.

The Cabinet Mountain region was subject to folding and faulting during mountain building. Structural anticlines and synclines are present throughout the Cabinet Mountain region. The folds range from tight to open and symmetrical to asymmetrical (USDA Forest Service and DEQ 2001). Structural features trend to the northwest or north, including primary faults, which tend to parallel folds. The region is part of the Libby Thrust Belt (USDA Forest Service and DEQ 2001) and principal faults in the Montanore analysis area are the Rock Lake fault and Libby Lake fault. The Rock Lake Fault separates the Rock Creek-Montanore deposit into two portions that are proposed to be operated as the Rock Creek and Montanore Projects, respectively.

Mine Development Associates (2003) report that Montanore sub-deposit mineralization occurs in the lower limb of a north-northwest plunging, breached overturned syncline (Figure 58 and Figure 59). The syncline axis extends to the east at about 45 degrees and the syncline opens to the northwest (Figure 58 and Figure 59). This creates a progressively wider flat-lying lower limb. The lower limb is not folded but dips about 15 degrees to the northwest. Mineralization in the Montanore sub-deposit is observable in the discovery outcrop of Revett Formation located on the north shore of Rock Lake.

The west-southwest boundary of mineralization is the northwest trending, near the vertical Rock Lake Fault that produced at least 2,500 feet of vertical displacement (Figure 58). The fault trends N35° W for about 12 miles with the down-dropped side to the northeast. The USGS (1981)

reports three periods of movement can be distinguished for the Rock Lake Fault. The syncline is bound on the east by several splays of the Libby Lake Fault (Figure 58).

Montanore Sub-deposit

The Rock Creek-Montanore deposit occurs in the Revett Formation, which is subdivided into the upper, middle, and lower Revett, based upon the amount of quartzite, silty-quartzite, and siltite. The majority of the silver and copper mineralization occurs in the A-D quartzite beds within the upper portion of the lower Revett. Within the Montanore sub-deposit, this mineralized zone lies on the lower limb of the overturned syncline, and is truncated on the west by the Rock Lake Fault (Figure 58), which separates the Montanore sub-deposit from the Rock Creek portion of the overall deposit. The mineralization is predominantly copper and copper-iron sulfides, including bornite, chalcocite, and chalcopyrite, deposited as intergranular cements in permeable beds and as replacements of clasts and earlier cements. Silver occurs as native silver, and in solid solution in copper minerals. Localized concentrations of ore minerals reflect faults and increased permeability in the quartzite beds (Boleneus *et al.* 2001). Lead sulfides (galena) and iron sulfides (pyrite and pyrrhotite) occur within haloes around the ore zone, but do not occur in any significant quantities within the ore.

The silver and copper ore zones are separated by a low-grade barren zone of disseminated and vein-hosted galena. The barren zone varies in thickness from more than 200 feet toward the west to 18 feet in the eastern portions of the mine area. The barren zone may be absent to the northeast.

Mineral zones, defined by the appearance, disappearance, and abundance of authigenic sulfide and gangue minerals, are developed that crosscut the stratigraphic units in the Revett Formation. This zonation is consistent with similar alteration mineralogy and crosscutting relationships observed in stratabound copper and silver deposits worldwide, and define the ore zone as well as key zones of environmental significance within the Revett Formation. The distribution and extent of mineral zonation in the Revett Formation is controlled by the migration paths of mineralizing fluids, which change in response to differences in porosity between the quartzite, siltite, and argillites that are variably interbedded across the basin. These zones are important, not only for the identification of ore, but also for identification of zones enriched in sulfides that are potentially acid generating when oxidized, such as pyrite and chalcopyrite, and those that are acid consuming, such as bornite, chalcocite, and digenite.

Mineralization within the Revett Formation is consistent throughout the depositional basin. As discussed by Maxim Technologies (2003) and Enviromin (2007), the Rock Creek-Montanore deposit was deposited within the Proterozoic Revett basin under the same conditions as the Troy deposit, which is located in a mineralogically comparable setting, but in different stratigraphic zones within the Revett Formation. The Troy deposit has been mined over the past 29 years, and a substantial amount of geological, mineralogical, and water quality data are available for this deposit that provide full-scale estimates of environmental geochemistry behavior. Analyses of drill samples from the Rock Creek-Montanore deposit have generated laboratory-based sets of mineralogical and geochemical information for comparison with the larger set of empirical data available from the Troy Mine. Comparison of data from the Rock Creek-Montanore and Troy deposits provides useful information regarding the potential geochemical effects of development of the Montanore sub-deposit.

Mineral zonation was studied in the Troy deposit, where alteration zones were described in detail based on the dominant sulfide and distinct non-sulfide minerals present, along with color. These

alteration styles include the pyrite-calcite, galena-calcite, chalcopyrite-calcite, bornite-calcite, chalcocite-chlorite, chaldopyrite-ankerite, hematite-calcite, and albite zones (Hayes and Einaudi 1986). The pyrite-calcite and chalcopyrite-ankerite boundary represents the boundary between reduced and oxidized rocks, along which ore-grade minerals, bornite-calcite and chalcocite-chlorite zones were deposited. The chalcopyrite-calcite and galena-calcite zones lie between the ore and the pyrite-calcite zone. In the Montanore sub-deposit, the barren "lead" zone associated with the ore hosts galena as a primary mineral. The location and relative magnitude of the mineral zones is generally controlled by grain-size characteristics of individual stratigraphic units, although the alteration crosscuts stratigraphic units. A broad belt of pyrite-calcite occurs in the A-D beds of the lower Revett at both Troy and Rock Creek-Montanore deposits, with some variation in zone thickness related to local changes in sediment porosity (argillite vs. quartzite), as well as displacement by more recent structural activity. Because these zones host sulfide and carbonate minerals that could affect acid generation and neutralization potential, it is important to understand their occurrence within the Montanore sub-deposit.

In the Montanore sub-deposit, rock exposed in the stopes and adits would include both ore and the barren-lead zone of galena-calcite halo mineralization within the Revett Formation. In the adits, lesser amounts of chalcopyrite-calcite and pyrite-calcite alteration haloes also would be exposed within the lower Revett Formation, along with the Prichard and Burke Formations in the Ramsey Adits. It is possible that a small amount of rock from Wallace Formation would be intercepted in the Ramsey Adits as well. Six mineralogically and lithologically distinct rock units would be exposed underground or mined as waste rock at the proposed Montanore Mine.

MMC collected 11 representative samples from five drill holes and analyzed them for asbestos by Polarizing Light Microscopy. No asbestos fibers were detected in any sample (Jasper Geographics 2005).

Tailings Impoundments and LAD Areas Geology

Surficial geology at the proposed Little Cherry Creek Tailings Impoundment Site is dominated by Quaternary glacial deposits (Figure 60). More detailed geology and cross sections of the tailings impoundment are provided in Figure 61. As much as 300 feet of unconsolidated deposits of silt, sand, and gravel overlie the Wallace Formation in both tailings impoundment areas. Fine-grained glacial lake (glaciolacustrine) materials dominate the center and eastern portion of tailings impoundment sites and interfinger with intermixed silt, sand, and gravel glaciofluvial materials present on the western portion of the site. Based on borehole data, a buried glaciofluvial channel, more than 370 feet thick, trends west to east through the center of the Little Cherry Creek Tailings Impoundment Site (Figure 61) (Klohn Crippen 2005).

Bedrock exposures are limited in the Little Cherry Creek Tailings Impoundment Site, and have been observed mainly on the steep, north-facing slopes exposed in Little Cherry Creek downstream of the tailings dam and hills to the north and south of the tailings impoundment above an elevation of 3,700 feet. Most bedrock fractures appear to be related to sedimentary bedding planes, but drill samples also show occasional near-vertical joints and irregular fractures. The approximate thickness of surficial sediments at the Little Cherry Creek Tailings Impoundment Site is (Klohn Crippen 2005):

- North Saddle Dam = 135 feet
- South Saddle Dam = 10 to 45 feet

- Diversion Dam = 20 to 50 feet
- Main Dam = 20 to over 300 feet

The surficial geology of the Poorman Tailings Impoundment Site is similar to that of the Little Cherry Creek Tailings Impoundment Site (Figure 60). Based on a resistivity survey, the thickness of the unconsolidated deposits range from near zero in the upper portions of the basin to more than 300 feet thick in the lowest portion of the basin (Chen-Northern 1989). The resistivity survey and limited drilling did not identify any buried channels, as occurs in the Little Cherry Creek site.

The two LAD Areas are located on a low, flat ridge between lower Ramsey Creek and Poorman Creek. Geology at the two LAD Areas is mapped as Quaternary glacial deposits, similar to those found in the tailings impoundment sites (Figure 60). These glacial deposits form an eastward-thickening wedge up to 200 feet thick, beginning at an elevation of about 4,000 feet on the flank of the Cabinet Mountains (USDA Forest Service *et al.* 1992). Ravalli Group bedrock is present west of the LAD Areas and rocks of the Wallace Formation are to the east.

3.8.2.2 Mining History

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

In the late 1890s and then in the 1920s and 1930s, several small prospects were worked west of the Cabinet Mountains divide in and around the analysis area. The Freeman prospect occurs just above Copper Lake. It consists of a few short adits and workings in a northwest-striking copper and silver quartz vein in the Copper Lake Fault Zone. Located about 1 mile south of the proposed Montanore Mine, the Heidelberg Mine consists of several adits just south of Rock Lake. Most of these old workings were driven on gold-bearing quartz veins in what is probably the southern end of the Snowshoe Fault near its junction with the Rock Lake Fault. Numerous other diggings (generally shallow) occur along the northwest-trending faults that cut the area. All of these prospects were short lived and very little, if any, production was created (Gibson 1948).

In the 1960s through the 1980s, three major deposits and numerous smaller deposits containing stratabound copper and silver mineralization were discovered. These discoveries were confined to the Revett Formation and situated within a narrow belt extending from the Coeur d'Alene Mining District north to about the Kootenai River. ASARCO brought the 64-million-ton Spar Lake deposit into production in late 1981, producing about 4.2 million ounces of silver and 18,000 tons of copper per year from the Troy Mine. The 145-million-ton Rock Creek sub-deposit in the CMW is the second deposit. The permitted Rock Creek Project proposes to mine this sub-deposit. The Montanore sub-deposit, proposed for mining by the Montanore Project, is the third deposit.

3.8.3 Environmental Consequences

3.8.3.1 Mine Drainage and Trace Element Release

3.8.3.1.1 Alternative 1 – No Mine

If the proposed Montanore Project were not constructed, mine drainage issues would be limited to the negligible influence of exposed Prichard and Burke Formations in the Libby Adit, seepage from the reclaimed waste rock pile located near to the adit, and ground water discharge from the adit. Disturbances on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.8.3.1.2 Alternative 2 – MMC's Proposed Mine

Following a review of the mechanisms of acid production and trace element release, and a discussion of the use of the Troy deposit as a geochemical analog for the Rock Creek-Montanore deposit, the environmental geochemistry of material that would be mined or produced by the Montanore Project is described using data from the Rock Creek and Montanore sub-deposits, as well as the Troy deposit. These data include static whole rock metal concentrations, acid generation potential, and metal mobility test data, as well as kinetic test and monitoring data, which are summarized by project (Montanore, Rock Creek and Troy mines) for ore, tailings, and waste rock. Release of nitrate associated with blasting residues from mining is also discussed.

Acid Rock Drainage

Acid Rock Drainage (commonly called ARD) results from oxidation of iron-sulfide minerals during weathering. Iron sulfide, particularly pyrite (FeS_2), chalcopyrite ($CuFeS_2$), and pyrrhotite ($Fe_{1-x}S$) are the most common acid-producing sulfide minerals and much research is available on their oxidation (Price and Errington 1998). Impurities in a sulfide crystal structure, or oxidative differences between iron sulfides and copper, zinc or lead sulfides also will determine oxidation rates. Other types of sulfides, such as bornite (Cu_5FeS_4), chalcocite (Cu_2S), digenite (Cu_9S_5), sphalerite (ZnS) and galena (PbS) actually inhibit or decrease acidity because they either do not produce acid or consume it as a result of oxidation (Maxim Technologies 2003; Enviromin 2007).

Sulfide minerals are chemically unstable in oxidizing air- and water-rich surface environments, where they are far from the equilibrium conditions of the reduced subsurface environment in which they were formed. Acid generation results from the oxidation of iron sulfide minerals to ferrous iron (Fe (II) or Fe^{+2}) and sulfuric acid (H_2SO_4). If not neutralized, acidity will cause a drop in pH and enhance metal solubility. At low pH (below pH 4), ferric iron (Fe III or Fe^{+3}) produced by acid-loving iron oxidizing bacteria speeds up sulfide minerals oxidation, so that the amount of acid produced increases as pH declines. If acidity generated through these processes at the mineral surface is neutralized, by buffering minerals such as calcium carbonate, or water is not available to transport oxidation products away from the mineral surface, ARD is unlikely to develop. Where water is available, and there is insufficient neutralizing capacity (buffering) of the solution, ARD can occur. In either case, metals released into solution can remain soluble depending upon their individual sensitivity to pH and oxidation.

The potential for ARD formation depends on the balance between the rates of acid-generating and acid-consuming reactions. ARD potential can be estimated using a static acid base accounting test, which calculates the difference in total concentration of acid neutralizing and acid generating minerals, *i.e.*, acid-base account (acid base potential) = neutralization potential - acid potential (ABA or ABP = NP – AP), in units of tons/thousand tons as calcium carbonate (T/kT $CaCO_3$). The calculated ABA is then compared to standards, wherein values less than -20 are considered acid producing, greater than 20 are considered non-acid generating, and values between -20 and 20 are considered to have uncertain acid generation potential. An alternative approach, comparing the ratio of NP/AP, uses criteria of less than 1 as acid producing, greater than 3 as non-acid generating, and between 1 and 3 as having an uncertain potential for acid production.

The net generation of acid from a rock or waste rock facility is related more to the reactivity of sulfide and neutralizing minerals than the total concentrations, so that static tests may over-predict potential for acid generation. The pH decrease associated with ARD occurs if acidity is produced at a faster rate than alkalinity or when neutralizing minerals are consumed by excess acid. The development of acid drainage is time-dependent and, at some sites, may form after many years of slow depletion in available alkalinity or slowly increasing sulfide oxidation (Price and Errington 1998). Kinetic test methods are used to evaluate rates of reaction when static methods suggest uncertain potential for ARD. Monitoring of long-term environmental chemistry in analogous geochemical settings also provides excellent predictive information. Drainage from acid-producing rocks typically contains elevated concentrations of metals, which are generally more soluble under acid conditions and can adversely affect water quality and aquatic life.

Microbial processes can speed up sulfide oxidation and significantly increase the acid production. The type of bacteria participating in sulfide oxidation depends on pH, as does the actual speed of oxidation by the organism. At near neutral pH, acid generation occurs primarily from chemical oxidation of sulfide, with biological oxidation playing only a minor role in sulfur oxidation. If the neutralizing potential of a rock material is exhausted and pH values drop below 4, iron oxidizing bacteria will rapidly oxidize ferrous iron (Fe II) of pyrite directly to ferric iron (Fe III), which can oxidize the sulfide minerals. *Acidiothiobacillus ferrooxidans* is a common bacterium that makes energy by oxidizing iron sulfide minerals in low pH environments (below pH 4) (Schippers *et al.* 2000).

Mineralogic texture and chemistry must be evaluated when testing for acid generation and metal release potential. For example, decreased contact with oxygen and water due to cementation limits oxidation. Temperature, pH, and availability of water and oxygen also affect rock-water interactions.

Trace Element Release

The release of trace elements from mined rock is a concern regardless of the potential for acid generation. Although acidic drainage presents the greatest potential for metal release, elevated concentrations of some metals can also occur in seepage from “non-acid generating” or near-neutral mine wastes. This happens when metals that are released during sulfide oxidation remain soluble after any related acidity is neutralized. This is particularly true for metals and metalloids, such as zinc, manganese, and arsenic, which have enhanced solubility under neutral or alkaline conditions. Elevated concentrations of metals can also result from dissolution of non-acidic metal-bearing minerals such as salts.

Nitrates

Elevated concentrations of the nutrients nitrate and ammonia can also occur in mine drainage, as a result of explosive use in blasting during mining.

Troy as a Geochemical Analog for the Montanore Sub-Deposit

The Troy Mine, developed within the upper quartzites of the Revett Formation, is an excellent depositional and mineralogical analog for the zone of quartzite to be mined within the upper-most part of the lower Revett Formation at both of the Montanore and Rock Creek sub-deposits. Geological analogs are valuable techniques for predicting acid generation potential and/or water quality from a proposed mine site (Price and Errington 1998). This type of comparison is based on the assumption that mineralization formed under comparable conditions within the same geological formation, and having undergone similar geological alteration and deformation, will have similar mineralogy and texture and, thus, similar potential for oxidation and leaching under comparable weathering conditions. Further, the ability to study environmental geochemical processes in the same rocks at full scale and under real-time weathering conditions provides a valuable basis for evaluation of laboratory test results.

Hayes (1983) and Hayes and Einaudi (1986) conducted detailed mineral paragenesis studies of the Revett-style mineralization, and concluded that the geochemistry and risk for ARD from the Troy and Rock Creek-Montanore deposits are the same, as defined by the observed mineral zonation (Hayes 1997). Hayes found that the ore zones of both deposits contain no detectable amounts of pyrite. There are two ore zones identified for both the Rock Creek Project and the Troy Mine. One ore zone is primarily bornite, digenite, calcite, and native silver and the other ore zone contains chalcocite and chlorite. In another study comparing mineralization for the two deposits, Maxim Technologies (2003) showed that the three Revett-style copper and silver deposits in northwest Montana cannot be statistically distinguished from one another based on copper or silver assay values.

Hayes reported that pyrite characteristically occurs in disseminated and isolated clots within the quartzite, where it is isolated from weathering, rather than on fracture surfaces. He also found that the post-sulfide cementation of quartz overgrowths on all grains resulted in an impermeable rock with little porosity. These results were confirmed in independent studies of Rock Creek ore in a validation study conducted for the Forest Service in 2003 (Maxim Technologies 2003; Enviromin 2007).

Four alteration halos surrounding the ore zones in both the Troy and Rock Creek-Montanore deposits would be mined as waste rock to varying degrees depending upon the geometry of underground workings at each mine. The amount of pyrite (FeS_2) also varies within these four halos, so potential for acid generation and trace element release may vary more between the three projects for waste rock than it would for ore. According to Hayes' data, of the two halos that immediately surround the ore zones, the chalcopyrite-ankerite halo contains "local trace" amounts of pyrite, while the chalcopyrite-calcite halo contains no pyrite. The galena-calcite halo contains a "trace" amount (less than 0.1 percent) of pyrite, while in the pyrite-calcite halo "…pyrite constitutes only an average of about 0.2 volume-percent of the rock whereas the calcite constitutes an average of around 4%." Pyrrhotite ($Fe_{1-x}S$) was logged infrequently in trace amounts in the pyrite-calcite halo only. These mineralogy data suggest that waste rock mined from the alteration haloes has some potential for acid generation and trace element release that should be fully evaluated for the proposed Montanore Project.

Geochemistry of Revett-style Copper and Silver Deposits in Northwestern Montana

Table 74 summarizes the thousands of surface and drill samples that were collected, described in detail for mineralogy including sulfide content, and assayed for copper and silver, for each of the three Revett-style copper and silver projects, Rock Creek, Montanore, and Troy. This table also summarizes the average acid base potential and whole rock metal contents for ore, tailings, and waste rock. The number and type of metal mobility and kinetic humidity cell tests is also shown. These data have been collected over time by various investigators and reflect differences in style and methods of sampling for each of the three Revett-style copper and silver deposits. For example, considerably more waste rock data were collected for the Montanore sub-deposit, while tailings characterization is more comprehensive for the Rock Creek sub-deposit. The most detailed studies of Revett-style copper and silver ore mineralization were conducted underground at the Troy Mine, where exposures could be studied in mine workings. Together, the mineralogy and chemistry of ore, tailings, and waste rock, data from the Rock Creek-Montanore and Troy deposits provide a comprehensive baseline assessment of the rock to be mined at any individual mine site. For these reasons, the following discussion focuses on data collected specifically for the proposed Montanore Project, but includes information for the Rock Creek sub-deposit and Troy mines as well.

MMC has prepared comprehensive summary tables of the available static geochemistry data characterizing rock for the proposed Montanore and Rock Creek mines by test method in tables appended to their waste rock management plan (Geomatrix 2007b). Average values for acid base potential, whole rock chemistry, and assays based on these data, along with data reported by Maxim Technologies (2003) and DEQ (1996), Golder (1996), USDA Forest Service *et al.* (1992), USDA Forest Service and DEQ 2001), and Schafer (1992, 1997) are presented in Table 74. This table provides a brief summary of data presented and discussed in a geochemistry technical summary report (Enviromin 2007).

Ore

As discussed above, ore in the Rock Creek-Montanore deposit contains the copper sulfide minerals bornite, chalcocite, and digenite. These minerals are not acid generating and based on delineation criteria, no pyrite occurs in the ore zone. Minor chalcopyrite and galena occur as interbeds and in halos with calcite at the periphery of the deposit. Fewer quantitative mineralogy analyses are available for the Montanore sub-deposit than have been collected for the Rock Creek and Troy deposits, but extensive hand specimen descriptions (for thousands of described intervals, as shown in Table 74) are available in drill logs. Detailed mineralogy studies indicate that 90 percent of the sulfide is encapsulated in the silica matrix of the quartzite in the Revett Formation at the Troy Mine (Enviromin 2007). Formation of quartz overgrowths were documented for both the Troy (Hayes 1983) and Rock Creek deposits (Maxim Technologies 2003), and based on the comparable depositional and post-depositional history, can be expected to have resulted in silica encapsulation of sulfide minerals within the Montanore sub-deposit as well. A summary of the average sulfur and acid generation potential data characterizing ore for the Rock Creek-Montanore and Troy deposits is presented in Table 74. Ranges reported below for these averages are based on discussion and data presented by Enviromin 2007.

Table 74. Geochemical Data for Northwestern Montana Revett-Style Copper and Silver Deposits.

	Montanore						Rock Creek						Troy					
	Ore		Tailing		Waste		Ore		Tailing		Waste		Ore		Tailing+		Waste	
	n	mean	n	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean	*n*	mean
Static Acid Generation Potential	$				$		**,$$		$$,**		**,$$,+		+		$,#			
ABA, T/1000T CaCO3 (NP:AP ratio)	*35*	-4 (0.8)	*1**	8 (25.8)	*155*		*36*	5.1 (2.3)	*1*	10 (11)	28	3.6 (5.8)	*17*	7.6 (7)	*2*	2.8 (2.1)	*nd*	
Prichard Formation					*70*	7 (3.7)					nd	bd						
Burke Formation					*19*	15 (12)					nd	nd						
Lower Revett Formation					*66*	4.2 (3.5)					14	3.6 (1.9)						
Total Sulfur, weight %	*35*	0.29	*1*	0.01			*34*	0.25	*13*	0.012	14	0.12	*17*	0.2	*2*	0.08		
Total Sulfur, weight % adjusted	*nd*						*34*	0.1			10	0.1	*17*	0.05	*nd*			
Whole Rock/Metals							**,+		**		**,+		+		#			
Copper, ppm	*nd*		*nd*		*nd*		*35*	6382	*13*	391	14	31	*16*	6456	*2*	818	*nd*	
Silver, ppm	*nd*		*nd*		*nd*		*35*	31	*13*	2.5	14	<2	*16*	26	*2*	7	*nd*	
Assay Claim Validation	**						**						**					
Copper, ppm	*213*	5400					*347*	6700					*269*	7100				
Silver, ppm	*213*	45.7					*347*	52.2					*269*	44.5				
Sulfur, weight %, calculated from Cu	*213*	0.14					*347*	0.17					*282*	0.18				
Mineralogical Analysis		**			**		**				**		**				**	
Quantitative/analytical							*10*	nr			2	nr	*>100*	nr			*>100*	nr
Feet drilled	*1,500*	nr			2.375	nr	*3000*	nr			4000	nr	*11429*	nr			*45000*	nr
Mineralogy Descriptions	*1,000*	nr			2,000	nr	*1500*	nr			3000	nr	*4798*	nr			*22500*	nr
Assays	*1,500*	nr			2,375	nr	*7255*	nr			nd	nr	*3799*	nr			*nd*	nr
Metal Mobility Tests	$						$,**				&,**				#			
EPA TOX (EPA Method 1310)											1							
TCLP (EPA Method 1311)	*1*	nr	*nd*		nd		*13*	nr	nd		14		*nd*		*1*	nr	*nd*	
SPLP (EPA Method 1312)							*12*	nr			14				*1*	nr		
Humidity Cell Tests, final pH, s.u.	*1*	6.98	*1*	8.9	4	7.15	*1*	neutral					*nd*				*nd*	

*After Enviromin, 2007, Tables 3-1, 3-2, 3-3, based on ^Geomatrix, 2007b; **Maxim, 2003; +MDEQ,1996; #Golder, 1996; $USFS 1992; $$USFS, 2001; Schafer, 1992; Schafer, 1996,*

ABA-Acid Base Account | *ABA = NP-AP* | *NP-neutralization potential* | *AP-acid generation potential* | *reported in tons per 1000 tons rock equivalent calcium carbonate*

EPA TOX - EPA Toxicity Test, EPA Method 1310. | *TCLP-Toxicity Characteristics Leaching Procedure, EPA Method 1311* | *SPLP- Synthetic Precipitation Leachability Procedure , EPA Method 1312;*

n = number of samples | *nd - data not available* | *nr - mean value not relevant* | * Tailing sample from Troy | % percent

Results of whole rock analyses of ore from the Montanore sub-deposit are summarized in Table 74 along with results for ore samples from the Rock Creek sub-deposit and the Troy mine. At Montanore, total sulfur ranged from 0.01 to 1 percent and averaged 0.29 percent (n=35). Total sulfur ranged from 0.01 to 0.78 percent (averaging 0.25 percent) at the Rock Creek sub-deposit (n = 34) and from 0.06 to 0.31 percent (averaging 0.2 percent) at the Troy Mine (n = 16).

Thirty-five ABA (n= 35) tests have been provided for samples of ore from Montanore drill core. An additional 36 Rock Creek and 17 Troy Mine ore samples were analyzed for acid base account, as summarized in Table 74. The Montanore sub-deposit static test data indicate that the ore has uncertain potential to generate acid, with an average acid-base potential (ABP) of -4 T/kT $CaCO_3$ (with values ranging from -24 to 11 T/kT $CaCO_3$) and an NP:AP ratio of 0.8. MMC reports an ABA value for an individual representative sample of Montanore ore as -3 T/kT $CaCO_3$ (Geomatrix 2007b). Values for the Rock Creek and Troy samples have an average ABP of 5 T/kT $CaCO_3$ and 8 T/kT $CaCO_3$, respectively, in spite of low total sulfide.

Static tests of acid generation potential are based on nitric acid digestion of all available sulfide from a finely ground rock flour. As noted previously, this conservatively estimates the potential for oxidation of encapsulated sulfides, as well as the potential for sulfides to generate acid because all sulfide is assumed to be acid-generating pyrite. The use of an acid base account without adjustment thus overstates the potential for acid generation by the copper sulfide minerals and ignores the effects of encapsulation. For this reason, in its study of the Rock Creek sub-deposit, the DEQ appropriately reduced the total sulfide by the amount of sulfur that would correspond to the measured copper concentration (based on the assumption that all sulfide is chalcocite, Cu_2S, so that there is one atom of sulfide for every 2 atoms of copper) to account for non-acid generating copper sulfides (DEQ 1996). The DEQ therefore adjusted the total reactive sulfur using the copper assays, reducing the estimated sulfur content for the Rock Creek sub-deposit from an average of 0.26 weight percent to 0.1 weight percent, as shown in Table 74. The average for the Troy Mine was similarly reduced from 0.18 to 0.04 percent. Because copper concentrations were not reported for the Montanore sub-deposit samples that were analyzed for total sulfur, this correction cannot be made, although the principle is equally valid for the Montanore portion of the Rock Creek-Montanore deposit and would result in a predicted average value around 0.1 percent. The significant difference in inferred acid generation risk with and without this important mineralogical correction to account for non-acid generating copper sulfides is evident in Figure 62 and Figure 63.

The neutralization and acid generation potential of samples from the Montanore sub-deposit are compared to the regulatory NP:AP ratio guidelines (acid < 1 <uncertain< 3 < non-acid) in Figure 62. These data, which are also based on the conservative assumption that all sulfide is acid-generating pyrite, suggest that most samples have potential to generate acid or are uncertain in terms of ARD risk. These data overestimate the acid generation potential of the Montanore sub-deposit, which would more closely resemble the trends shown in Figure 63 for the Rock Creek and Troy deposits if Montanore data could be adjusted to account for acid-consuming copper sulfide minerals.

Another important source of data characterizing sulfide content is the thousands of ore intercepts that were assayed for copper and silver, operationally at the Troy Mine and for validation of the Montanore, Rock Creek and Troy claims. Given the very consistent copper sulfide mineralogy of the ore, it is possible to calculate the range of sulfide content based on the assumption that the copper to sulfur ratio of 2:1 for chalcocite, Cu_2S, represents the ore grade chalcocite

mineralization. MMC compiled assay data for 213 samples of ore from Forest Service claim validation studies for the Montanore Project, along with 347 samples from the Rock Creek claims, and 282 samples from the Troy claims, as shown in Figure 64. (Maxim Technologies 2003). Very few samples have a calculated sulfide concentration above 0.4 percent in any one of the deposits, and the average sulfide concentration is less than 0.2 percent. This distribution agrees with the results reported by DEQ (1996). Also, 89 percent, 94 percent, and 89 percent of samples (for the Troy, Montanore, and Rock Creek claims, respectively) have total sulfide concentrations below 0.3 percent, which is a commonly accepted cutoff value below which potential acidification is not of concern (Jambor *et al.* 2000, Price *et al.* 1997). In other words, although concentrations above this commonly accepted threshold of 0.3 percent do occur, they represent a consistently small fraction of the studied population in both the Troy and Rock Creek-Montanore deposits.

The potential for acid generation at the proposed Montanore Project was tested for an ore composite in a standard humidity cell test (Schafer 1992). The ore composite, which had an uncertain acid generating potential with an ABA of -14.5 T/kT $CaCO_3$, showed a low amount of oxidation with a final pH of 7 and low concentrations of sulfate and acidity (Geomatrix 2007b). In the composite leachate analyzed in week 6, a low copper concentration was detected; both copper and manganese were detected in week 12 (Geomatrix 2007b, Table B2). Results of this single analysis support the conclusion that Montanore ore would not be acid generating but may release trace elements at a near-neutral pH, and therefore agree with empirical water quality data from ore exposures in the Troy Mine (Geomatrix 2007b), which show no ARD, near-neutral pH, and low concentrations of copper and manganese.

Additional whole rock analyses were conducted using the alkali fusion method for one sample from the Montanore sub-deposit (Geomatrix 2007b). Whole rock analyses using a four acid ALS Chemex method MEMS61 also were completed for 12 additional Rock Creek ore samples (Maxim Technologies 2003). These data indicate that ore from these deposits is anomalous in copper, silver, and lead (Table 74).

Tests of metal mobility are more suitable for prediction of trace element release than simple whole rock digestions, regardless of digestion method. Two individual tests of metal mobility were run for ore from the proposed Montanore Project, each using a different method. One sample tested in a humidity cell indicated neutral pH with low concentrations of copper (0.02-0.04 mg/L) and manganese (0.03 mg/L) (Schafer 1992). In another test of Revett ore from the Montanore deposit using the EPA Method 1311 (Toxicity Characteristic Leaching Procedure, TCLP) analysis, barium, copper, and lead were detected in the leachate. The TCLP analysis is a conservative test designed more for waste classification than for prediction of environmental mobility, which would be expected to yield higher metal concentrations due to the types of conditions created in the test. No laboratory tests of metal mobility for ore from the Troy Mine were conducted, but water monitoring in the adit provides a very useful measure of potential trace metal release from ore and waste rock exposed together in underground workings. Comparison of dissolved and total water concentrations from the Troy adit (where ore was exposed underground) suggests that very low concentrations of some dissolved metals (copper, silver, lead, and manganese) may be detected in solution, but the majority of detected metals (aluminum, arsenic, silver, barium, copper, lead, manganese, and zinc) are associated with sediment (Enviromin 2007). This association makes the Troy data a conservative basis for assessment of the Montanore mine, because the Troy adits are inclines where there is little potential for settling of solids prior

to discharge. The adits at Montanore would be declines, with water draining into the workings where solids can settle prior to discharge.

The association of metals with suspended sediment in mine and adit water raises important considerations for water management. For example, the total copper concentration is predicted to average 30.9 mg/L, well above the dissolved concentration of 0.075 mg/L, based on data from the Troy adit in 1987. Copper concentrations in the discharge from the Troy Mine underground workings and adits decreased to an arithmetic mean of 0.15 mg/L during an interim closure (1993-1998, Geomatrix 2007a, Table 15). Following permanent closure of the Troy Mine, rebound of the water table during the 50 years following mining would reduce oxidation in the workings by orders of magnitude, because the dissolved concentration of oxygen in water is 10,000 times lower than in air. Construction of portal plugs and backfilling between the plugs would reduce available oxygen by reducing rates of ground water recharge with aerated surface water. Further, the rate of ground water movement through the mined workings would be slower, reducing the amount of suspended sediment that can be transported. The total copper concentration would be reduced under these conditions, to concentrations likely to be similar to those observed during interim closure condition in the Troy and Libby Adits, as described in Table 15 of MMC's MPDES application (Geomatrix 2007a).

Increased concentrations of nitrate are expected to be produced in blasted zones. At the Troy Mine, operational nitrate concentrations in water at the mine portal ranged up to 22 mg/L (USDA Forest Service *et al.* 1992, Table 6-14; Geomatrix 2007a). Post-operational concentrations at Montanore are predicted to be less than 8.8 and averaged 3.8 mg/L (USDA Forest Service and DEQ 2001). Predicted chemistries provided by MMC in their MPDES analysis for nitrate and ammonia concentrations in adit and mine water during construction (Geomatrix 2007a, Table 13) are based on Libby Adit and Troy Mine adit data collected during construction and mining operations. MMC predicted mean operational concentrations of nitrate in drainage from blasted rock exposed in adits would vary between 23 mg/L (the geometric mean) to 41 mg/L (the arithmetic mean) based on 97 measurements of water quality from in the Libby Adit that ranged between 2 to 310 mg/L). Ammonia is also predicted to be elevated (15.7 to 26.9 mg/L) during construction, with lower concentrations (0.69 mg/L) following construction. Post-construction discharge from ore zones are represented by chemistries measured in the Troy adits during interim mine closure from 1993-1998 (Geomatrix 2007a, Table 13). MMC has proposed to use emulsions with lower nitrate solubility to replace ammonium nitrate (ANFO-type) explosives, as a means of reducing nitrate and concentrations in adit/mine water during construction and operations (Geomatrix 2007a).

Tailings

Tailings chemistry is dominated more by the metallurgical process of sulfide and metal removal than by minor differences in the sulfide mineral content of ore, particularly within the very narrow range of sulfide content observed in Revett-style deposits. The process MMC proposes to use at the Montanore mill involves conventional flotation of rock ground to a range of particle sizes comparable to that proposed for the Rock Creek mill and in use at the Troy mill (MMI 2005a, MMC 2008). The ore would be finely ground, so that surface area available for interaction between the ground ore and water is greater than in the intact quartzite matrix, to optimize sulfide recovery during flotation.

The acid generation potential of tailings from the Rock Creek sub-deposit (11 T $CaCO_3$/kT) and the Troy mill (5.3 T $CaCO_3$/kT) were described in the original Montanore Project Final EIS (USDA Forest Service 1992). Chemistry for one tailings sample was reported for the Montanore Project (Schafer and Associates 1992) and additional data have been collected for both the Rock Creek and Troy Mines (Table 74). The tailings composite tested in a humidity cell had an ABA of 8 T $CaCO_3$/kT with an NP/AP ratio of 25.8 (Schafer and Associates 1992). Values reported by Golder (1996) for Troy mill tailings reduce the average ABA value to 2.8 T $CaCO_3$/kT in Table 74. Both the tailings effluent for the Montanore ore sample and water from the Troy tailings pond show neutral pH values and comparable (generally low) concentrations of major cations and anions, with excess alkalinity (Table 3). These results agree with those obtained during humidity cell tests, which show near-neutral pH and low level metal release.

The measured total sulfur values reported for tailings in Table 74 range from 0.01 to 0.08 percent. Additional testing of tailings generated through metallurgical testing of ore from archived Rock Creek core indicated copper recovery ranging from 75 to 99 percent with an average of 91 percent and sulfide recovery ranging from 80 to 99.2 percent, with an average of 94 percent (Maxim Technologies 2003). Whole rock analysis of the Rock Creek tailings subsamples was at or below detection at 0.01 percent sulfur for 13 of 14 samples; the fourteenth sample had a sulfur content of 0.02 percent. Although sulfide recovery was not measured for the Montanore ore metallurgical test, the copper recovery reported for the Montanore ore ranged from 86 to 97.5 percent and averaged 93 percent (Geomatrix 2007a). This value lies within the range of copper values reported for the Rock Creek ore. Given the similar average copper recovery, it is reasonable to assume that sulfide recovery would comparable to the values reported for Rock Creek and would yield similarly low residual sulfide values. Removal of 90 percent of the sulfur shown for the Montanore ore in Figure 64 suggests that less than 0.03 percent sulfur (average) would occur in the homogeneous tailings. The total sulfide content of rock in the ore zone ranges from below detection to 1.4 percent with the majority of samples below 0.4. Removal of 90 percent of the sulfide during processing yields a limited range of sulfide values between 0.002 and 0.15 percent, values which would have essentially no acid generation potential. Similarly, the copper and silver content of the ore also would be reduced to one-tenth of the original concentrations. The overall risk of ARD formation by tailings from Montanore after several hundred years is estimated to be low (Klohn Crippen 2005).

Although the NP/AP ratios for the Troy tailings ranged from <0.2 to 3.33, with an average value of 2.1, and therefore suggest potential for ARD formation, the sulfur concentrations measured in tailings was less than 0.1 percent. Such a low concentration of sulfide is unlikely to generate acid. The reported ratio values therefore reflect the sensitivity of ratios calculated for low NP and AP values, which can vary significantly when values in the numerator or denominator are small, and do not necessarily indicate acid generation potential. Further, water from the Troy tailings impoundment is not acidic after nearly 20 years of monitoring (Table 75).

The similar mineralogy and range of silver and copper assay values for the Rock Creek-Montanore and Troy deposits, as well as the use of the same flotation method for all three mills, implies that tailings chemistry would be comparable at the three mines. This is confirmed by results of humidity cell tests of ore (prior to removal of sulfide by flotation) from the Montanore and Rock Creek ore, which were not acid generating and released little to no trace metal (Schafer and Associates 1992, 1997). Synthetic Precipitation Leaching Procedure (SPLP) testing of tailings from Troy indicates that tailings seepage would not yield highly elevated metal-enriched leachate, although the metals barium, chromium, copper, iron, lead, manganese, and zinc were

Table 75. Tailings Effluent Water Chemistry.

Parameter	Troy Tailings Impoundment† Arithmetic Mean		Montanore Tailings Impoundment Effluent‡
pH – lab, s.u.	7.5		7.5
Specific Conductivity – lab, µmhos/cm	366		214
hardness	72		—
Total Dissolved Solids	—		131
Calcium	19		12
Magnesium	6		2.3
Sodium	20		12
Potassium	29		—
Chloride	6		6.1
Sulfate	23		12
Alkalinity (bicarbonate)	80		76
Nitrate	15.9		—
Ammonia	7.2		—
Metals	**Total**	**Dissolved**	**—**
Aluminum	0.5	—	—
Arsenic	0.02	<0.005	—
Cadmium	0.0017	0.002	—
Copper	0.8	0.037	—
Iron	2.3	0.05	—
Lead	0.126	0.015	—
Manganese	1.9	0.429	—
Mercury	0.0005	0.001	—
Silver	0.0042	0.004	—
Zinc	0.078	0.019	—

All units are milligrams per liter (mg/L) unless otherwise noted.
s. u. = standard units.
µmhos/cm = micromhos per centimeter.
†After data presented in Table 17, Geomatrix 2007a.
‡After data presented in Table 16-9, MMI 2005a.
"—"= Data not reported.

detected at low concentrations (Golder 1996). Analysis of tailings liquids obtained in bench scale flotation tests of Rock Creek ore indicated a similar suite of detectable total barium, cadmium, lead, silver, copper, manganese, iron, and aluminum. Of these elements, manganese, iron, and aluminum were detected in concentrations suggesting that some changes in tailings water quality above secondary maximum contaminant levels (SMCL) values for iron and manganese may occur during operations, when colloidal and suspended solids are entrained in tailings water (Maxim Technologies 2003). Humidity cell test data indicated elevated concentrations of copper, iron, lead, manganese, and zinc under neutral pH conditions. The potential for such changes in metal concentration, as observed in tailings water and monitored ground water below the Troy impoundment, would be the same at the Montanore tailings impoundment. MMC would collect tailings seepage and return it to the impoundment during operations and at closure until it met water quality standards.

As additional samples become available for metallurgical testing during final exploration and early operations, a more representative set of samples would be available for testing. Additional testing of acid generation and metal release potential would be completed for the samples, to supplement the kinetic test data available from a single humidity cell test. Any analyses based on pilot scale metallurgical tests would be more consistent than would be expected under processing plant conditions, where variations in efficiency and recovery are not only anticipated but documented daily. Such monitoring can be used to check for changes in sulfide content of tailings during operations.

Waste Rock

According to MMC, 2.01 million bank cubic yards (M bcy) of waste rock would be generated by the Montanore Project throughout mine life (Geomatrix 2007b). MMC estimates that 0.75 M bcy would be produced during construction, from the Prichard Formation (0.44 M bcy), the Prichard-Burke transition zone (0.05 M bcy), the Burke Formation (0.08 M bcy) and the lower Revett Formations (0.17 M bcy). About 75 percent of this rock would be used for tailings impoundment dam construction, with the remaining 25 percent used underground as backfill. Waste rock also would be used to construct portal pads and the plant site. Waste rock used for construction would be stockpiled temporarily at LAD Area 1, along with ore produced during development work. A detailed description of waste rock production, handling, placement, and management is provided in MMC's waste rock management plan (Geomatrix 2007b).

The first waste rock (0.1 M bcy) to be produced would come from the Burke and lower Revett Formations, where they would be exposed in the Libby Adit. Waste rock from the zones of the lower Revett Formation in these workings would include rock from the *chalcopyrite-calcite* and *pyrite-calcite* alteration halo zones, as well as the *galena-calcite* halo (barren lead zone), although the proposed mining method would minimize production in the barren lead zone operationally. About 0.3 M bcy of additional waste rock would be mined from the Prichard, Burke and Wallace Formations during construction of the Ramsey Adits, which may have variable mineralogy and chemistry between the Rock Creek-Montanore and Troy deposits. Six geologically distinct units would therefore be mined as waste rock, three from the Revett Formation and one each from the remaining formations, which are listed above. An estimated 0.7 M bcy of lower Revett Formation waste rock would be generated during preproduction development of the underground crusher, station, main stopes, haulage drifts, ore/waste passes, and access ramps, and would be used for constructing portions of the tailings dam, the mill facility, and the Ramsey portal area. An additional 0.41 M bcy of initial production waste rock also would be used to build the tailings starter dam. The remaining 0.5 M bcy of production waste rock would be placed underground as backfill in mined-out areas (Geomatrix 2007b).

Of the three Montana Revett-style mine projects, the majority of waste rock characterization was completed for the Montanore Project. The only reported data for the Prichard and Burke Formations are from data collected for the 1992 Montanore Project Final EIS (USDA Forest Service *et al.* 1992). A total of 155 acid base account analyses have been reported for the Revett, Prichard, and Burke Formations in the Montanore sub-deposit, as shown in Table 74. A smaller number of waste rock samples (n=28) also were characterized for the Rock Creek sub-deposit.

Prichard and Burke Formations. Acid generation and neutralization potential data for 89 samples of Prichard and Burke Formation waste rock from the Libby Adit at Montanore (USDA Forest Service *et al.* 1992, reported by Geomatrix 2007a, Table A-6) suggest that these waste rock

lithologies have variable potential to generate acid and release trace elements at a near-neutral pH. The Prichard Formation acid base potential varies from -20 to 54 T/kT $CaCO_3$ (NP:AP 0.1 to 43), with an average ABP of 7 T/kT $CaCO_3$ (NP/AP 3.7) for 70 samples. The Burke Formation (which in this summary includes the Burke-Prichard transition zone) has an acid base potential that varies from -6 to 49 T/kT $CaCO_3$ (NP:AP 0 to 49), with an average ABP of 15 T/kT $CaCO_3$ (average NP/AP equals 12) for 19 samples. More detailed analysis of these data are provided in a geochemistry technical summary report (Enviromin 2007). These data suggest that most of the Prichard Formation rock exposed in the adits has uncertain potential to generate acid and release metals and show that roughly half of the samples have total sulfur contents above 0.3. Portions of the Prichard Formation should therefore be considered to have uncertain potential to generate acid and release metals. The Burke Formation does not appear to have as great a potential for acid generation and trace element release, but it is more difficult to be conclusive because many of the samples come from the blended transition zone (both Burke and Prichard Formations together) where the individual lithology is unclear in the data. Because the sulfide mineralogy of the waste rock units is more variable and complex than in ore, this interpretation is, appropriately, based on the assumption that all sulfide is reactive for the purpose of evaluating acid generation potential.

Two humidity cell tests of Prichard Formation waste rock from the Montanore sub-deposit were reported by Schafer and Associates (1992) and are summarized by Geomatrix in Tables B-1, B-2, and B-3 (Geomatrix 2007b). One sample of Prichard Formation waste rock had a moderately low ABP value of -2 T/kT $CaCO_3$, while the second had a relatively higher ABP of 18 T/kT $CaCO_3$. Although pH of effluent started around pH 7 for both cells, final pH was 6.9 with low conductivity and sulfate concentrations for both cells. The humidity cell test with lower ABP did produce more sulfate over the life of the test, along with higher acidity which exceeded alkalinity late in the 20 week test.

These kinetic test data, which do not support acid generation from the Prichard Formation, agree with the monitoring data from the Libby Adit, where sulfide oxidation does not appear to be occurring in the exposed portions of the Prichard and Burke Formations within the Libby Adit after 10 years of exposure (Geomatrix 2007a, Table 16). Sulfate concentrations reported in 1997, 1998 and 2007 were less than 23 mg/L, indicating that few reactive sulfides are oxidizing to form sulfate. The average pH in the Libby Adit water has remained consistently neutral. In 1993, the reported pH was 7.7, while in 1997 pH ranged from 6.6 to 7.9 and averaged 7.4. In 1998, pH ranged from 7 to 8.6 and averaged 7.6. Elevated nitrate concentrations and two low mercury concentrations in 1997 decreased to near background concentrations or were not detected in 1998. Together with the humidity cell data, this information suggests that static tests may over-predict acid generation potential for the Prichard Formation.

There are no metal mobility tests of waste rock samples from the Prichard and Burke Formations at the proposed Montanore Project. Metal concentrations in humidity cell effluent for two tests of the Prichard Formation waste rock showed low, but detectable concentrations of arsenic, iron, manganese, and zinc (Geomatrix 2007b). Occasional low concentrations of iron, manganese, and zinc were detected in Libby Adit water during 1997 and 1998 (Geomatrix 2007a). Low dissolved metal concentrations were found in a sample collected in 2006 (MMC 2006).

Lower Revett Formation. Whole rock data (analysis by the alkali fusion method) for three representative samples from the lower Revett Formation waste rock (hanging wall, foot wall, and barren zone) and an average for three samples collected from the Rock Creek waste rock (analysis by previous unknown method) are summarized by Geomatrix (2007b, Table A-1).

Whole rock data are presented for 14 additional samples of Revett Formation waste rock from the Rock Creek sub-deposit by Maxim Technologies (2003). These samples are variably enriched in copper, iron, lead, and zinc, depending upon style of alteration. No whole rock data were reported for lower Revett Formation samples collected from the Montanore sub-deposit.

Average acid-base potential for waste rock in the lower Revett Formation at the proposed Montanore Project ranges from 3.2 to 6.0 T/kT as $CaCO_3$ with NP values ranging from 2.2 to 4.6 (Figure 62). The average ABP for the lower Revett Formation waste rock is +4.2, with an NP/AP ratio of 3.5 for 66 samples. ABP data for quartzite, siltite, and silty quartzite waste rock from the Revett Formation at the proposed Montanore Project (Geomatrix 2007b, Table A-5), indicate less potential to generate acid than was observed for the samples collected from the Prichard and Pritchard/Burke transition zones exposed in the Libby Adit. The style of halo mineralization present in these rocks is not described for these samples, despite the potential importance of the sulfide variation in influencing potential to produce acid drainage. Because of the silica encapsulation of sulfide minerals within the Revett quartzite, static numbers are most likely conservative in estimating the true acid generation potential of the rock. Additional ABP analyses of composites of lower Revett Formation waste rock are summarized by Geomatrix (2007b, Table A-3).

The Rock Creek Project EIS described one waste rock composite (of three Revett Formation waste rock samples) that was analyzed for acid generation potential and was found to be net neutralizing, with an ABP of 11 and an NP/AP ratio > 11 (USDA Forest Service and DEQ 2001). The DEQ collected and analyzed 10 additional samples of waste rock from the Rock Creek sub-deposit (DEQ 1996). Half of these samples fall into the uncertain range based on NP/AP criteria (acid 1 < uncertain < 3 non-acid), and all of the samples fall into that category based on ABA (acid < - 20 < uncertain < + 20 non-acid) criteria. The non-sulfate sulfur concentration is low, ranging from 0.01 to 0.20 wt percent and averaging less than 0.1 percent in the 10 samples collected by DEQ. Three of the samples collected by the DEQ were from the Prichard Formation, with the remainder from the lower Revett quartzite.

During a third-party geochemical review of the Rock Creek Project funded by the Forest Service, 14 analyses of acid generation potential, whole rock metal content, and metal release potential were conducted to supplement the 12 analyses originally provided for samples of waste rock from the Revett Formation (Maxim Technologies 2003). These data, along with composites reported in the 1992 Montanore Project Final EIS, bring the total number of waste rock analyses for the Rock Creek sub-deposit to 28, as shown in Table 74; these samples have an ABP of 3.6 T/kT $CaCO_3$, with an NP/AP ratio of 5.8. A summary table comparing waste rock from the Rock Creek and Montanore sub-deposits is provided as Table A-7 by Geomatrix (2007b). The data illustrate the strong similarity in acid base potential and NP/AP ratios for waste rock to be mined from the two projects proposed for development within the Rock Creek-Montanore deposit.

Humidity cell tests of two samples of Revett Formation waste rock also were reported by Schafer and Associates (1992). These represent the hanging wall (with an ABP of -15 T/kT $CaCO_3$) and the barren lead zone (with an ABP of -1 T/kT $CaCO_3$). The hanging wall sample showed low sulfate release with an ending pH over 8, while the barren lead zone was consistently lower at pH 6. Both tests showed relatively high rates of acid production that exceeded alkalinity throughout the test and data indicate that these rocks, particularly the barren lead zone, have potential to generate acid.

Metal mobility for samples of Revett Formation waste rock has been evaluated using multiple test methods. Three TCLP analyses of Revett Formation waste rock are reported by Geomatrix (2007b, Table A-2), which contained low concentrations of barium, copper, and lead. An average chemistry for three EPA Toxicity (EPA Method 1310) tests of Revett Formation waste rock is also reported by Geomatrix (2007b, Table A-2), which had detectable calcium, magnesium, and copper. These results are similar to results reported for the whole rock metal analyses, the SPLP (EPA method 1312), and TCLP (EPA method 1311) metal mobility tests that were completed for the 14 Rock Creek waste rock samples described above (as reported by Maxim Technologies 2003 in Enviromin 2007). Apart from calcium and magnesium, no metals were detected in SPLP extracts of the waste rock, which uses an unbuffered weak inorganic acid extraction. Concentrations of copper and lead in the waste rock were detected in the more strongly acidic TCLP extractions, although at considerably lower concentrations than reported for the ore zone. Iron was also detected at a relatively high concentration (up to 29 mg/L) in the TCLP extraction (buffered pH 5 organic acid). In contrast, of the unbuffered SPLP analyses of the same waste rock, only one had a detectable iron concentration of 0.2 mg/L, well below the applicable standard. This indicates that the TCLP, a test designed for the identification of hazardous wastes rather than measurement of metal mobility, overestimates potential metal mobility due to the high acid concentration and the artificially lower pH of 5 used in the test.

Effluent from a humidity cell test of waste rock from the lower Revett Formation had low but detectable concentrations of copper and manganese (Schafer and Associates 1992). A humidity cell test of waste rock from a high grade portion of the lead-rich barren zone produced elevated concentrations of lead, manganese, and zinc. Portions of the barren zone have elevated concentrations of lead, and soluble copper and lead also were detected in weak-acid extracted samples of the lower Revett Formation. The suite of trace elements run for some of the metal mobility tests was limited and should be expanded during operational validation, by testing for a more complete suite of regulated trace elements.

In the Troy Mine, the overlying galena halo zone and the pyrite halo zone were not mined and are therefore not exposed in the workings, due to site-specific geological factors influencing mine facility design. Undisturbed, these zones are not creating acid rock conditions, as samples of the underground mine water following seepage through these zones consistently show neutral to slightly alkaline pH values between 7.2 to 7.4. The Troy Mine does have near-neutral trace element releases at this pH. None of the lower Revett rock was exposed in the Libby Adit, so it is not possible to evaluate its weathering chemistry using those monitoring data.

Nitrate concentrations are less affected by the primary mineralogy of the rock than by the blasting practices used in mining. The water quality data reported for the Libby and Troy adits during and after construction are representative of the chemistry that would be expected at the proposed Montanore Project. Post construction values reported for the Libby Adit in 1997 and 1998 ranged from below detection to 1.9 mg/L, and averaged 0.26 mg/L. Based on the plan for use of emulsion explosives, contributions of nitrate and ammonia are predicted at low/high concentrations of 15 and 25 mg/L nitrate and 5 and 10 mg/L ammonia, based on values measured at the Libby Adit during construction, but intermittent discharge of nitrate and ammonia in seepage would be likely. Post construction values reported for the Libby Adit in 1997 and 1998 ranged from below detection to 1.9 mg/L, and averaged 0.26 mg/L.

Mine Drainage – ARD and Trace Element Release

The risk of acid generation for rock exposed in underground workings or for tailings would be low, with some potential for release of select metals at a near-neutral pH and a high potential for release of nitrate due to blasting. Low acid generation potential exists for a fraction of the total waste rock volume in portions of the Prichard Formation and moderate potential exists within in the halo zones of the Revett Formation, which MMC proposes to mitigate through selective handling (particularly of the barren lead zone) and further evaluation by sampling and characterization during mine development and operations. Portions of the waste rock at Montanore have the potential to release trace elements at a near-neutral pH.

Ore in Underground Workings and Stockpiles

As there has been no historical development of ore within the Montanore deposit, the proposed action would modify the existing underground environment. Ore would be exposed within the mine workings and stockpiled temporarily at the LAD Area 1, during construction of the tailings impoundment. Encapsulation of the sulfides in quartzite would limit the extent of sulfide oxidation within the stockpile and the majority of oxidized sulfide would not be acid generating. There would therefore be low potential for acid generation or trace metal release during the construction period when ore would be stockpiled. Any minor amount of metal (most likely, copper, manganese, and zinc) released into water as a result of stockpiled ore oxidation would be treated if necessary to meet MPDES limits before water would be discharged. During operations, ore would be shipped to the mill for processing where 90 percent of the sulfides would be removed.

Waste rock and ore that was not mined underground would remain exposed in the mine walls, where it would undergo oxidation where it is exposed to oxygen and air. The massive nature of the quartzite that hosts Revett-style ore at the Montanore Project would limit the relative reactive surface area of sulfide exposed to oxidation, which would be on the order of less than a few percent of the total surface area of sulfide contained in the rock. Such low exposed sulfide surface area within the quartzite, and the dominant presence of sulfides that are not acid generating, would substantially reduce the potential for acid generation by ore exposed underground. The small percentage of exposed sulfides would oxidize to form copper oxide and sulfate minerals with variable solubility, with potential to release metals into solution at a near-neutral pH. Results reported for dissolved metals in Troy adit/mine water are consistent with the metal release values reported for metal mobility and kinetic tests. Low concentrations of dissolved copper, manganese, and zinc are predicted for release by weathering ore and waste rock in the adit walls, with higher total recoverable concentrations that reflect the importance of sediment transport of metals. For this reason, water from the Libby and Ramsey adits would be treated prior to discharge to surface or ground water if necessary to meet water quality standards. The probable need for treatment is low, due to the configuration of adits at Montanore, which would have lower levels of suspended sediment than have been observed at Troy.

Tailings

Following grinding, pH adjustment, and removal of sulfide during processing, the homogenous tailings would have an elevated pH with a low sulfide content below 0.1 percent. Acid generation would be unlikely, but tests of metal mobility and monitoring at the Troy Mine suggest that some metals would be mobile in tailings effluent at a near-neutral pH, particularly during operations when suspended sediments may transport colloidal and adsorbed metals. These metals include copper, cadmium, iron, lead, silver, manganese, and aluminum. Nitrate and ammonia

concentrations also would be elevated. Only dissolved constituents have potential to move beyond the impoundment and potentially affect ground water and surface water quality.

Waste Rock

The environmental geochemistry data indicate that some portions of the lower Revett Formation have potential to generate acid, while others do not. Kinetic data support potential for acid generation from the lower Revett sulfide halos, particularly the barren lead zone that separates the two ore zones. While the risk would be mitigated by MMC's plan to limit mining of rock from the barren lead zone, this risk would need additional characterization through additional sampling and testing prior to waste rock placement as the Libby and Ramsey adits were advanced through the lower Revett halo zones. This would be particularly important for delineation of waste rock that would be used in construction of surface facilities.

Comparison of the static results with kinetic test data indicates that static test data overestimate the potential for acid formation from the Prichard Formation waste rock, a conclusion that is supported by the lack of acid drainage from the exposed section of Prichard Formation in the Libby Adit or from the rock stockpiled in front of the Libby Adit. This interpretation would need to be validated with additional sampling within the Prichard Formation prior to use of rock as construction material. Also, metal mobility should be better characterized for any rock to be used as construction material, regardless of acid generation potential. Waste mined from the Burke Formation appears unlikely to generate acid, although additional data would need to be collected for it to confirm preliminary conclusions based on the small number of samples studied previously from the Libby Adit. Samples of the silty carbonate-rich Wallace Formation, which has not been characterized in terms of acid generation or trace metal release potential, would need to be obtained for testing during adit construction as well. These characterization questions would be partially addressed by the waste rock management plan proposed by MMC.

3.8.3.1.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative and Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The risk associated with ore in underground workings and stockpiles in these alternatives would be the same as in Alternative 2. No major difference in potential for acid rock drainage or trace element release would likely result from the construction of adits in Libby Creek and not Ramsey Creek in Alternatives 3 and 4. Minor differences in the relative volumes of waste rock lithologies intercepted in the alternative adit locations that would be developed under Alternatives 3 and 4 may alter the overall potential for changes in water quality, depending upon the relative volume of Prichard and Revett Formation halo rock to be mined. Any change would likely be minor and would be identified through sampling and analysis during adit development. The chemistry of tailings and waste rock used for impoundment construction would not change as a result of constructing impoundments in alternative locations.

The volume of waste rock to be mined from each halo zone, and the area of the underground workings that would expose the halo zone, are not yet fully defined because final mine plans would depend upon results of proposed development work. As noted above, the potential for trace metal release from waste rock used in construction or placed in stockpiles, would primarily be a function of how much waste rock was mined from the reactive portions of the lower Revett Formation sulfide halos and the Prichard Formation, and how much metal those rock types would release. The described zonation patterns (in and of themselves) do not indicate a higher potential for acid generation and metal leaching at Montanore Project than that observed at the Troy Mine,

but suggest the need for sampling at a level sufficient to represent the observed variability. These relationships would be further defined in the Libby Adit evaluation program, when waste rock in these zones can be sampled more comprehensively, and would be used to support further testing. Ore collected during this development work should be used to conduct further metallurgical testing with a goal of obtaining tailings reject for kinetic and metal mobility test work using a comprehensive suite of elements. This would be needed to support the results of a single kinetic test of tailings reported to date, and to provide a more comprehensive suite of metal mobility data for evaluating tailings impoundment performance.

Some additional sampling would be conducted during final exploration and operations, when a more representative section of waste rock would be available for sampling. As shown in Table 74, characterization of metal release potential for tailings and waste rock is limited and would be expanded in Alternatives 3 and 4. Descriptions of mineralogy in rocks exposed in the evaluation adit ore zone (for the Revett Formation) and development adits (for the Burke and Prichard Formations) would be used to identify subpopulations with sulfide halo zone overprints and their relative importance in terms of tonnage to be mined, to guide sampling density. If the Wallace Formation were intercepted, samples of this lithology would be collected and characterized. This information would be used to redefine geochemical units for characterization and evaluate potential selective handling and encapsulation requirements.

Solute loading from waste rock was not incorporated into MPDES models of water quality impacts (Geomatrix 2007a). Although waste rock would only be stockpiled for a short period of time near LAD Area 1, and runoff from that pile would only be contained using stormwater controls, waste rock would be used throughout the site for construction purposes, using selective handling criteria that are not yet defined. It is therefore not clear which fraction of the Revett Formation waste rock would be brought to the surface. Once more detailed information about the Revett and Prichard Formations waste rock is available, along with updated predictions of metal loading for tailings, these source terms should be incorporated into updated mass load calculations.

3.8.3.2 Topography and Geomorphology

3.8.3.2.1 Alternative 1 – No Mine

In this alternative, existing topography and geomorphology features would remain similar to existing conditions. The disturbances at the Libby Adit site would eventually be reclaimed. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.8.3.2.2 Alternative 2 – MMC's Proposed Mine

Under Alternative 2, changes to the existing topography and geomorphology would occur. Construction of surface facilities would alter the existing topography and surface drainage system at the Libby Creek and Ramsey Creek facilities, the LAD Areas, and at the Little Cherry Creek Impoundment Site.

Existing disturbance at the Libby Adit area includes cut-and-fill benches, a waste rock pile, and a percolation pond. The waste rock would eventually be used for construction of the tailings

impoundment. At the end of operations, the cut areas and percolation pond would be filled and waste rock from the bench would be backfilled into the adit for closure. Except for a small bench that would remain following mining operations, the post-mining topography would approximate pre-mining conditions. All drainage and diversion structures used during the operational period would be removed and the pre-mining drainage restored.

The Ramsey Portal and Plant Site also would be constructed using a cut-and-fill sequence with the fill supplemented with waste rock from adit construction. Cut slopes would be benched at 15- to 25-foot intervals. The channel of Ramsey Creek would not be altered. Following operations, the mine portal would be backfilled to the approximate original topography. Benches for the mill, electrical substation, and thickener would be graded into the existing hillside. All drainage and diversion structures used during the operational period at the mill site would be removed and the pre-mining drainage restored. Drainage on the remaining fill material would be riprapped if necessary to control erosion.

Two LAD Areas would be constructed adjacent to lower Ramsey Creek. Soil stockpiles, a waste rock stockpile, sediment ponds and a lined surge pond are proposed within the LAD Areas. Following operations, the LAD Areas and associated ponds and soils storage piles would be graded to match pre-mining topography.

The largest alteration of existing topography would be construction of a 620-acre tailings impoundment within the Little Cherry Creek drainage. The impoundment dam would have a height of about 318 feet. The Seepage Collection Dam, downgradient from the main impoundment dam, would have a height of 30 feet and would remain in place until water quality objectives were met. Following removal, the Seepage Collection Dam and Pond would be graded to blend in with the original slope. The tailings impoundment would remain as a permanent landform following mining operations.

Little Cherry Creek would be diverted 10,800 feet around the proposed impoundment and channeled to two unnamed tributaries of Libby Creek. One channel (Channel A) is about 6,200 long intermittent channel that currently flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. Another channel (Channel B) is south of the lower reach of Channel A and is about 3,000 feet long. A control gate structure would be installed where Channel A and B join to control flow in both channels. An energy dissipater would be constructed at the outlet section of both channels to reduce flow velocity of water entering Libby Creek. MMC identified a variety of measures that may be used to control erosion and sedimentation and to create aquatic habitat (Geomatrix 2006b).

During operations, the former Little Cherry Creek channel below the tailings impoundment would no longer receive surface flows from above the Seepage Collection Dam. The unnamed tributaries to Libby Creek would be subject to increased flows and sediment load from the diversion. The Diversion Dam and Channel would remain a permanent feature. The Diversion Channel would cross the hill slope face, east of the tailings impoundment, before discharging into the unnamed tributary to Libby Creek. Post-mining, the North Saddle Dam would be removed and runoff would drain from the reclaimed tailings impoundment surface toward the Bear Creek drainage. The increased flow in Bear Creek is not expected to alter the channel’s geomorphology. The drainage toward Bear Creek would be a permanent feature.

3.8.3.2.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The effect on topography and geomorphology of the LAD Areas and the Libby Adit Site in Alternative 3 would be essentially the same as Alternative 2. MMC would develop plans to shape slopes of the Libby Plant Site, mine portal areas, and Libby Adit Site to closely resemble the surrounding landscape. Final grading would involve regrading and shaping flat surfaces to blend with the adjacent landscape and have natural dendritic drainages. Additional fill would be used as necessary to create smooth transitions between human-made and natural landforms.

Construction of the Libby Plant Site on the northeast toe of the ridge between Libby Creek and Ramsey Creek would involve the grading and changing of current topography on about 110 acres. The construction of a level plant site on the toe of the ridge would require cut and fill to accommodate the plant area. Following operations, the mine portal would be backfilled to the approximate original topography. Like Alternative 2, benches for the mill, electrical substation, and thickener would be graded to match the surrounding hill slope. Based on preliminary analysis, no waste rock would be needed to construct the Libby Plant Site.

The largest alteration of existing topography would be construction of a 590-acre tailings Poorman Tailings Impoundment between Poorman and Little Cherry creeks. The impoundment dam would have a maximum height of about 360 feet. The Seepage Collection Pond, downgradient from the main impoundment dam would have a height of 30 feet. Four small, unnamed channels tributary to Libby Creek would be filled by the tailings impoundment. A large diversion channel around the impoundment would not be needed. The tailings impoundment and dam would remain as a permanent landform following mining operations. Post-mining impoundment runoff would be routed to a natural channel to Little Cherry Creek.

3.8.3.2.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Changes in topography and geomorphology at the Libby Adit Site, the Libby Plant Site, and LAD Areas would be the same as Alternative 3. The effect of the Little Cherry Creek Tailings Impoundment and Seepage Collection Pond would be the same as Alternative 2. MMC would develop plans to shape slopes of the Libby Plant Site, mine portal areas, and Libby Adit Site to closely resemble the surrounding landscape. Final grading would involve regrading and shaping flat surfaces to blend with the adjacent landscape and have natural dendritic drainages. Additional fill would be used as necessary to create smooth transitions between human-made and natural landforms.

During final design, MMC would complete a hydraulic and hydrologic (H&H) analysis of the proposed channel and submit it to the lead agencies and the Corps for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. The channel would begin at the outlet of the engineered channel and would be designed to have the following characteristics:

- The diversion channel corridor would have a constructed floodplain and terrace that would allow passage of the 100-year flow volume
- The stream portion of the diversion corridor would be constructed to meet the 2-year flow event volume and approximate the cross-section, profile, and channel materials of similar sized watersheds found in the analysis area
- Establishment of fish habitat similar to that currently provided by Little Cherry Creek

These measures would increase the long-term stability of the channel. Post-mining, runoff from the impoundment surface would be channeled to the riprapped Little Cherry Creek Diversion Channel.

3.8.3.2.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. No changes to the topography or geomorphology would occur in Alternative A due to the transmission line. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.8.3.2.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Under the North Miller Creek Alternative, minor changes to the topography would occur during the construction of 9.9 miles of new access roads for structure installation. Proposed access roads in the tributary drainage of Miller Creek would cut into steep hill slopes, changing the slopes and slightly modifying hill slope drainage. Additional skid trails would be needed for timber harvest operations. All transmission line alternatives would cross and require roads in areas of steep slopes (those greater than 30 percent), or subject to slope failure. These areas are discussed in section 3.18, *Soils and Reclamation* and quantified in Table 134.

After transmission line construction was completed, available soil would be placed on the new roads and the road reseeded. The existing road prism would remain throughout mine operations until the transmission line was removed. After the transmission line was removed, all new roads would be bladed and recontoured to match existing topography, obliterating the road prism. Where culverts were removed, stream banks would be recontoured and reseeded. Over the long term, the transmission line would not substantially alter the area's topography or geomorphology, assuming construction did not destabilize slopes.

3.8.3.2.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Minor changes to the topography would occur during the construction of new access roads for structure installation in the Modified North Miller Creek Alternative. Use of helicopter construction for structures within the North Miller Creek area would avoid construction of roads in the steep areas of the tributary drainage of Miller Creek. About 3.0 miles of new access roads would be constructed in the lower elevation valleys to provide structure access.

After transmission line construction was completed, all new roads on National Forest System lands would be placed in intermittent stored service using a variety of treatment methods to achieve desired conditions for other resources. Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. Plum Creek may require a newly constructed road be decommissioned after construction if adverse resource impacts occurred, such as on steep, erosive soils. Over the long term, the transmission line would not substantially alter the area's topography or geomorphology assuming construction does not destabilize slopes.

3.8.3.2.8 Alternative D – Miller Creek Transmission Line Alternative

In the Miller Creek Alternative, minor changes to the topography would occur during the construction of new access roads for structure installation. About 3.0 miles of new access roads would be constructed in the lower elevation valleys to provide structure access. Roads would be managed as in Alternative C. Over the long term, the transmission line would not substantially alter the area's topography or geomorphology, assuming construction does not destabilize slopes.

3.8.3.2.9 Alternative E – West Fisher Creek Transmission Line Alternative

In the West Fisher Creek Alternative, minor changes to the topography would occur during the construction of new access roads for structure installation. About 3.5 miles of new access roads would be constructed in the lower elevation valleys to provide structure access. Roads would be managed as in Alternative C. Over the long term, the transmission line would not substantially alter the area's topography or geomorphology assuming construction does not destabilize slopes.

3.8.3.3 Cumulative Effects

Both MMC and Rock Creek Resources, the owner of the Rock Creek Project, would mine stratabound copper-silver deposits from metasedimentary rock under the CMW. The combined size of both the Rock Creek and the Montanore ore bodies may be as large as 279 million tons. The mineral deposits are sufficiently isolated from each other that no cumulative changes to topography, geomorphology, mine drainage or trace element release would occur. Construction and operation of both mines would likely result in more stringent requirements on other future minerals activities in the area 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 (USDA Forest Service and DEQ 2001).

3.8.3.4 Irreversible and Irretrievable Commitments

Up to 120 million tons of ore would be removed by the Montanore Project, with the remaining 25 to 35 percent of the ore body left for structural support of the mine workings. The future recovery of the remaining metals left for structural support would be unlikely. Construction and operation of the Montanore Project would result in the irreversible commitment of these resources. Construction of a tailings impoundment in all action alternatives would irreversibly alter the area's topography and geomorphology. Alternatives 2 and 4 would irreversibly alter the drainage of Little Cherry Creek.

3.8.3.5 Short-term Uses and Long-term Productivity

Construction of mine facilities other than a tailings impoundment, and roads for all transmission line alternatives, in all action alternatives would alter the area's topography. These changes would be short-term and, and on National Forest System lands, the area's topography would return to the approximate original contour during the reclamation phase. On private land, Plum Creek may opt to retain the roads built for the transmission line.

3.8.3.6 Unavoidable Adverse Environmental Effects

The alteration of the area's topography and geomorphology in all action alternatives would be an unavoidable adverse effect.

3.9 Geotechnical Engineering

This section discusses the lead agencies' analysis of the risk of subsidence in the underground mine, and the stability of the tailings impoundment for Alternatives 2 and 4 (Little Cherry Creek) and Alternative 3 (Poorman). Also included in this section is a comparison of the two alternative tailings sites.

3.9.1 Analysis Area and Methods

Underground mining causes a redistribution of stress, which in turn causes displacements in the affected strata. Subsidence is the result of downward displacement of the rock mass from closure or collapse of underground openings. The analysis area for the subsidence evaluation is the area overlying the ore body. MMC completed a geotechnical evaluation of the potential for subsidence due to underground mining at the Montanore deposit (Call & Nicholas, Inc. 2005a). The lead agencies completed an evaluation of the project's potential for subsidence and to describe potential environmental impacts of subsidence if it were to occur (Agapito Associates, Inc. 2007b).

The analysis area for the impoundment stability analysis is Little Cherry Creek in Alternatives 2 and 4, and between Poorman and Little Cherry creeks in Alternative 3. Klohn Crippen (2005) updated the original design of the proposed Little Cherry Creek tailings impoundment and all associated facilities, incorporating changes in technologies since 1990, and making design changes required by the lead agencies in their 1992 project approvals. The lead agencies developed a design for an alternative Poorman Tailings Impoundment Site between Poorman and Little Cherry creeks in Alternative 3 in sufficient detail to analyze the effects in this EIS.

3.9.2 Affected Environment

3.9.2.1 Structural Geology and Tectonics

The Montanore Project site lies within the Libby thrust belt, which formed along the western edge of the North American Craton. The Libby thrust belt is one of a series of major north-northwest trending structural features north of the Lewis and Clark line, a major tectonic boundary within the Continental Plate in the western U.S. The Libby thrust belt is bounded to the west and northwest by the Moyie thrust system, and to the southwest by the Hope fault (Klohn Crippen 2005).

The Lewis and Clark line is a prominent fault zone comprising strike-slip, dip-slip and oblique-slip faults that extend from the vicinity of Wallace, Idaho to east of Helena, Montana. Faults in this zone have been intermittently active from Middle Proterozoic to Holocene time and have the potential to produce damaging earthquakes. About 12 major faults make up the Lewis and Clark zone and include the St. Marys-Helena Valley, Bald Butte, Ninemile, and Osburn faults, which have had right separation or slip ranging between 6.8 to 17 miles. Most of this displacement is thought to have occurred during Late Cretaceous time (Klohn Crippen 2005).

3.9.2.2 Seismicity and Seismic Hazard

The analysis area is located at the northern end of the Intermountain Seismic Belt, which extends from southern Nevada northward through Utah and eastern Idaho and western Montana. In western Montana, the Intermountain Seismic Belt is up to 62 miles wide. The Intermountain

Seismic Belt is characterized by moderate to large earthquakes with shallow focal depths. Historical seismicity has concentrated along the Intermountain Seismic Belt, which extends as far north as Kalispell, located about 58 miles east of the impoundment sites. (Klohn Crippen 2005)

Five faults identified as being potentially active in the last 1.6 million years are located within 50 miles of the impoundment sites. The closest known potentially active fault to the Montanore Project site is the Bull Lake Fault, located about 11 miles west of the project site. The Bull Lake Fault was used to estimate the site seismicity and is summarized in Table 76 (Klohn Crippen 2005). The site is located in a moderately active seismic area. The design maximum credible earthquake (MCE) is a potential Magnitude 7.0 earthquake on the Bull Lake Fault, which results in a peak ground acceleration of 0.22 g. The fault is part of a series of northwest-southeast trending faults, although the activity along the fault is uncertain. Larger faults, which typically are associated with larger seismic events, are located farther away and do not control the design seismicity.

Table 76. Maximum Credible Earthquake and Site Seismicity.

Magnitude (M)	M7.0
MCE Assumed Epicentral Distance	12 miles (19 km)
Source	Bull Lake Fault, classified as later Quaternary, <700,000 years old and potentially active.
Peak Bedrock Acceleration (average from attenuation relations)	0.22 g(*) (average from attenuation relations)
Duration of Significant Shaking	27 seconds

*g = gravitational acceleration (32.2 ft/sec^2).
Source: Klohn Crippen 2005.

3.9.2.3 Avalanches and Landslides

Numerous avalanche chutes occur in both upper Libby Creek and Ramsey Creek valleys. The only facility within an avalanche chute path is the Libby Adit Site (Figure 47). Three avalanche chutes are near the Libby Adit Site. The Upper Libby Adit Site, proposed in Alternative 3, is between two avalanche chutes. Because of the high elevation of the chute tops and the narrow widths of the valleys below, avalanches can cross valleys and move up the opposite side.

No landslides or unstable slopes were identified near the Ramsey Plant Site, the Libby Adit, or the two tailings impoundment sites. Fine-grained soils derived from glaciolacustrine silts and clays are susceptible to slope failures if undercut. Section 3.18.3.1.2, *Glaciolacustrine Soils* discusses these soils in more detail.

3.9.3 Environmental Consequences

3.9.3.1 Subsidence

3.9.3.1.1 Alternative 1 – No Mine

No mining would occur; therefore, the potential for mining-related subsidence would not be present. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the

permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Potential subsidence from the Libby Adit would be mitigated by backfilling the entire adit length that occurs in unconsolidated bedrock.

3.9.3.1.2 Alternative 2 – MMC's Proposed Mine

Summary

The lead agencies' evaluation (Agapito Associates, Inc. 2007b) concluded that chimney subsidence breaching the surface to form sinkholes is unlikely given the geotechnical setting and the mine plan proposed by MMC. Isolated roof failure and chimney subsidence to some height above the workings is likely, however, and resulting impacts to ground water should be evaluated. It is estimated that chimney subsidence impacts to ground water may occur up to about 400 feet above the mine workings. The agencies' evaluation concluded that trough subsidence, while not likely, cannot be entirely dismissed at the current level of design. Final design criteria would be submitted for the agencies' approval to help ensure that unplanned subsidence would not occur.

Introduction

Underground mining causes a redistribution of stress, which in turn causes displacements in the affected strata. Subsidence is the result of downward displacement of the rock mass from closure or collapse of underground openings. The terms "subsidence" and "surface subsidence" are generally used interchangeably; however, subsidence has the potential to affect ground water where it is encountered, even where subsidence has not progressed to the surface.

The magnitude and extent of mining-induced subsidence are directly related to the type and extent of the mining activity. In partial-extraction mining (such as the room-and-pillar method proposed for the Montanore Project), rock strength is estimated and pillars are sized and left permanently to support the overburden, so that subsidence is not planned to occur during active mining. Subsidence after mine abandonment due to time-dependent pillar, roof, or floor failure may still occur and may be the dominant form of subsidence in room-and-pillar mining without pillar recovery (Singh 1992). Residual subsidence may occur tens or even hundreds of years after active mining (Thorburn and Reed 1977; Mahar and Marino 1981).

The two major modes of subsidence associated with mining are chimney subsidence and trough subsidence. Chimney subsidence is associated with roof collapse over small areas, such as individual drifts (Figure 68). The collapsed strata cave progressively upward toward the surface, in a chimney-like fashion, until either the increased volume of the caved material arrests cave progression, or caving breaches the surface. If chimney subsidence breaches the surface, a sinkhole is formed. Trough subsidence, in which a subsidence basin is formed above caved and sagging strata, occurs over larger areas (*e.g.*, many acres) and is associated with wide-scale pillar, roof, or floor failure. This may include pillar punching into the roof or floor.

Geologic Setting

The ore deposit at Montanore occurs in two nearly parallel zones within the lower Revett Formation, part of the Belt Supergroup. The upper zone of the ore deposit is designated the B-1 Zone and the lower is called the B Zone. The average thickness of the B-1 Zone is 30 feet, while the B Zone averages 34 feet. A barren zone, ranging in thickness from 0 to 200 feet and averaging about 30 feet, separates the two ore zones. The orebody lies on the lower limb of an overturned syncline (Figure 58) that plunges to the northwest. The syncline is bounded to the west by the Rock Lake Fault, a steeply dipping normal fault, and to the east by the Libby Lake Fault.

Orebody dip follows the northwest plunge of the syncline, and ranges from about 5° to 50°. Dimensions of the orebody are approximately 2,000 feet wide by 11,000 feet long.

The lower Revett Formation consists primarily of quartzite with some siltite and silty quartzite beds. In addition to the Revett Formation, overlying rocks belong to the St. Regis and Wallace formations. The St. Regis Formation consists of siltites and argillites with some quartzite. The Wallace Formation consists of argillite, siltite, limestone, and dolomitic quartzite. Additional information about the geology of the mine area is found in section 3.8.2.1, *Geologic Setting.*

Several lakes exist over or adjacent to the orebody, including Rock Lake on the extreme southern end of the deposit (the orebody outcrops beneath and near Rock Lake), St. Paul Lake on the northern end, and the Libby Lakes near the eastern boundary. Additional information about the surface water resources in the mine area is found in section 3.11.3, *Affected Environment.*

Two other economic copper/silver deposits exist in the general vicinity of the Montanore Project. The Troy Mine (Spar Lake deposit) was permitted in 1979 and was in production until 1993 (U.S. Forest Service and Montana DEQ 2001). The mine was reopened in 2004, and was on maintenance status in the interim (Tetra Tech and R Squared 2006). The Rock Creek Project west of the Montanore Project currently is in the evaluation phase. Although these deposits are structurally different than the deposit at Montanore, the mineralogy of the ore zone at the three deposits is essentially identical (U.S. Forest Service and Montana DEQ 2001).

MMC's Plan to Minimize Subsidence

MMC has indicated that pillar and opening dimensions would be designed with the goal of preventing surface subsidence. Spans of about 40 feet to 45 feet are planned. A pillar design study (Call & Nicholas 2005a) recommended 62-foot-long pillars, 40-foot-wide openings, and pillar widths varying from 19.5 feet to 49 feet, including 2 additional feet of both width and length to compensate for blast damage. These pillar widths were based on the Wilson pillar design approach (Wilson 1972) and a 1.3 safety factor. Required pillar widths would increase with cover depth (the amount of rock overlying the mine) and pillar height. The Call & Nicholas pillar design study provided for a cover range of 1,000 feet to 3,800 feet. As part of the Libby Adit evaluation phase, MMC would conduct additional underground core drilling before developing final mine plans. The drilling would be used to collect detailed information on underground geologic structures, ore thicknesses, ore grades, and hydrology. MMC has not proposed any secondary recovery, or "pillar robbing," at the end of mining, and any change to the final mine plan would require the agencies' approval. Additional information about MMC's mine plan is discussed in section 2.4.2.1, *Mining*.

The thickness of the unmineralized zone overlying the ore body ranges from zero (0) feet at the outcrop at Rock Lake to about 3,800 feet near Libby Lakes (Agapito Associates, Inc. 2007b). Most of the ore body is overlain by between 2,000 and 3,500 feet of cover. To reduce possible subsidence risk and the interception of ground water in the potential subsidence area, MMC plans to observe a 500-foot vertical and horizontal buffer zone at the outcrop near Rock Lake. In addition, a 100-foot barrier pillar is planned as a buffer to the Rock Lake Fault. It is anticipated that additional developmental drilling would better define the fault zone and, thus, the limit of mining near the fault and lake. MMC may use a narrower barrier, with the agencies' prior approval, should additional testing determine that a smaller buffer zone would be adequate to protect against subsidence and/or hydrologic disturbance. Alternately, the additional testing may

indicate that a larger buffer zone would be necessary and MMC would be required to stay farther from the fault and/or lake.

Potential for Chimney Subsidence, and Likely Effects Were it to Occur

Due to the depth of cover over the mine workings, it is unlikely that chimney subsidence would breach the surface to form sinkholes (Agapito Associates, Inc. 2007b). Some roof failure at mine level would be likely over time, especially after mine abandonment. Caving propagation (incremental upward movement) to some height above the workings would likely occur. Should such caving occur, MMC's estimates of final cave height are between 150 feet and 380 feet, or 2.1 to 5.4 times the assumed maximum 70 feet mining height (Call & Nicholas 2006). Due to the thickness of rock overlying the Montanore ore body, and the buffers proposed by MMC, these cave heights would not breach the surface. Any ground water intercepted by the caved strata would be rapidly transmitted to the mine workings. A fractured zone with increased hydraulic conductivity may exist for some distance above the caved zone, but given the likely diameter of the caved zone (a few feet to tens of feet), the thickness of the fractured zone would be limited and not likely to reach the surface based on the amount of rock overlying the ore. No other direct impacts are anticipated should chimney subsidence occur.

Two chimney subsidence events that resulted in sinkholes at the Troy Mine, located about 17 miles northwest of Montanore, have been reported (Tetra Tech and R Squared 2006). As discussed in section 3.8, *Geology*, the mineralogy of the ore zone at the Troy Mine is similar to that of Montanore. Sinkhole #1 was initially observed in October 1997 (Call & Nicholas 2005b), about 4 years after the mine had been shut down. At that time, the sinkhole was about 8 feet deep and 15 feet in diameter. By spring 2005, the sinkhole had increased to about 50 to 55 feet deep and 50 feet in diameter. At the mine level, material from the East Fault, a north-northwest trending normal fault that dips at about 65° to the northeast, had accumulated in two separate drifts sometime between the mine closing in 1993 and spring of 2005. Based on measurements of the accumulation of fault material in the mine, estimation of the sinkhole volume, estimates of fault gouge bulking factors, spatial relationships between the East Fault and the mine workings, and other factors, Call & Nicholas (2005b) concluded that the sinkhole was probably not related to underground excavation.

A second sinkhole formed in February 2006, and both sinkholes #1 and #2 were analyzed by Tetra Tech and R Squared (2006). Sinkhole #2 was about 135 feet long and 100 feet wide, with a depth between 20 and 30 feet. It was first noticed 4 days after a ground failure and cave in the underground workings of the Troy Mine. Based on projections of the East Fault to the surface, the location of the sinkholes relative to these projections, and on calculations regarding swell factor and chimney size, Tetra Tech and R Squared concluded that the sinkholes were mining related.

While relevant to the analysis of subsidence potential at Montanore, the formation of sinkholes above the Troy Mine does not imply a similar risk of sinkhole formation at Montanore. The mining depths associated with the two Troy sinkholes were 270 feet and 320 feet, respectively (Tetra Tech and R Squared 2006). Minimum mining depth at Montanore would be 500 feet. Assuming similar mining heights, the increased depth at Montanore would reduce the likelihood of sinkhole subsidence, as would MMC's plan to leave a 100-foot horizontal buffer between mining activity and the Rock Lake Fault. No such plan was required at the Troy Mine, where the East Fault was routinely approached and/or penetrated as part of the mining operation. Had a mitigation plan similar to the Montanore plan been in place at the Troy Mine, it is unlikely that sinkhole subsidence would have occurred (Agapito Associates, Inc. 2007b).

Potential for Trough Subsidence, and Likely Effects Were it to Occur

MMC's design calls for stable pillars to be left in place, with no secondary recovery (retreat mining, or "pillar robbing"). If the design assumptions were met, trough subsidence and associated impacts would not occur. Any change to the final mine plan would require the agencies' approval. In order to quantify worst-case impacts, the remaining discussion in this section assumes that design assumptions were not met, and that trough subsidence occurred.

Trough subsidence over the workings due to unforeseen roof, pillar, or floor failure may result in maximum surface subsidence of 0.1 to 0.2 times the 70 feet mining height, or 7 feet to 14 feet. Surface subsidence would be much less than this if the width of failure at mine level were less than about 1.4 times the cover depth (Agapito Associates, Inc. 2007b). In this case, subsidence at the surface may be minimal or visually undetectable. If substantial surface subsidence were experienced, it would be measured over a surface area that somewhat approximates the area affected at mine level. The area affected at mine level is defined by the draw angle, the angle, in section, measured from the vertical, between the edge of the mine workings and the point on the surface at which subsidence is not detectable. A negative draw angle results in an affected surface area smaller than the area of failure, whereas the opposite is true for a positive draw angle. Based on case studies of initial draw angles in caving operations, it is estimated that the draw angle could vary from -12° to 28°. Using the latter as a worst-case scenario at maximum cover, subsidence could be measured for horizontal distances up to 2,000 feet beyond the footprint of failure. Surface damage is not likely to occur over the full angle of draw, but over the angle of critical deformation, which is typically about 10° less. Therefore, surface subsidence effects may occur up to 1,200 feet beyond the footprint of failure, based on an angle of critical deformation of 18°.

If design assumptions were not met and trough subsidence occurred, surface resources that may be affected include wildlife and vegetation, wetlands, and visual quality. Assuming this worst-case scenario, the lead agencies evaluation concluded the potential for impacts to these resources would be low (Agapito Associates, Inc. 2007b). The referenced report explains the conclusion in more detail.

Possible Impacts to Ground Water

Subsidence has the potential to affect ground water where it is encountered, even where subsidence has not progressed to the surface. Chimney or trough subsidence would have the potential to affect surface and ground water in several ways and the effects of subsidence on the hydrologic regime can be highly variable and complex. Numerous case studies have been presented in the literature, and conflicting conclusions between studies are common (Peng 1992). The major factors controlling subsidence effects on hydrology include the horizontal and vertical distance between the caved zone and the water resource and the hydrologic properties of the intervening strata. The severity of hydrologic damage decreases with distance from the subsidence and the presence of low permeability stratum. Peng (1992) suggest an angle of influence of 16° to 26° is appropriate for estimating the distance beyond which hydrologic resources should be unaffected.

Within the angle of influence, hydrologic effects are expected to vary according to where water resources were intercepted vertically. If unplanned trough subsidence occurred, rapid transmission of any ground water to the workings would be expected in the caved zone, for a distance of 2 to 8 times the mining height, or 140 feet to 560 feet, assuming a total mining height

of 70 feet (Agapito Associates, Inc. 2007b). A fractured zone would exist over the caved zone, extending perhaps 1,400 feet to 2,100 feet above the mine workings. Increased permeability would be associated with the fractured zone, and permeability would increase from the top of the fractured zone downward. Above the fractured zone, surface fissures may develop, but they probably would not to extend to the fractured zone, as tensile stresses would likely die out and become compressive at some distance beneath the surface. Ground water flows may be affected from the surface to the fractured zone; any such interruption would continue until post-mining hydraulic heads stabilize.

As previously discussed, the caving height associated with chimney subsidence is estimated between 150 feet and 380 feet, or 2.1 to 5.4 times the assumed maximum 70 feet mining height (Call & Nicholas 2006). Ground water within this zone would be transmitted to the workings. Increased permeability above this zone would exist, although the zone of increased permeability would likely be of limited extent. The effect on ground water hydrology is discussed in section 3.10.4.2.1, *Mine Area*.

The potential for chimney or trough subsidence would be largely a function of mine design, and MMC has addressed subsidence risk in prior rock mechanics evaluations. MMC has proposed collecting additional underground geotechnical data as part of its Libby Adit evaluation program. The evaluation program would provide additional data to assess subsidence potential, the risk of trough subsidence, and the potential of fractures above the mine workings to affect ground water.

3.9.3.1.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative and Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 3 and Alternative 4 would have the same risk of subsidence and are discussed together. MMC would undertake additional measures regarding pillar design, structural setting, interaction of mine voids and pillars in the two ore zones, and roof support analyses to finalize the support plan and mining span. These measures are described under Alternative 3, section 2.5.3.7, *Subsidence*. MMC would submit a final geotechnical monitoring plan to the agencies for approval following the completion of the Libby Adit evaluation program. The most valuable geotechnical data are obtained during mining itself. A rock mechanics program that includes the agencies' mitigations on pillar design, structural geology, interaction between workings, and entry stability and support would reduce the potential for trough subsidence.

3.9.3.2 Impoundment Stability

3.9.3.2.1 Alternative 1 – No Mine

The risk of an impoundment failure and associated impacts would not exist. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.9.3.2.2 Alternative 2 – MMC's Proposed Mine and Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The impoundment design in Alternative 2 would be the same as Alternative 4, and both alternatives are discussed together. Through the rest of this section, the impoundment design and

analysis is referred to only as the Alternative 2 design or impoundment. In Alternatives 3 and 4, during final design MMC would:

- Incorporate guidelines from the Idaho Administrative Code Safety of Dam Rules and the California Department of Water Resources, Division of Safety of Dams for seismic stability as appropriate
- Use more recent attenuation relationships that are based on instrumental records of attenuation collected in the United States and internationally (Spudich *et al.* 1999 and Boore *et al.* 1997)
- Conduct additional geotechnical investigations as needed to complete final design
- Complete circular failure plane assessments through the near-dam tailings and dam section and through the dam crest and slope
- Submit final design to the agencies for approval
- Fund a technical review of the final design by a technical review panel established by the lead agencies

The tailings impoundment dam in all alternatives would be considered by the DNRC as a high-hazard dam. The DNRC classifies a dam as high-hazard if it impounds more 50 acre-feet and the DNRC determines that a loss of human life is likely to occur within the flooded area as a result of failure of the dam. The hazard classification is based on the potential loss of life downstream and is not an assessment of the safety of the structure. Dams under a DEQ Operating Permit are exempt from Montana's Dam Safety Act.

MMC's design criteria are industry design standards for dam design and construction and have been established as measures of certainty for the design of safe earth and rock fill dams. The origin and basis of the criteria are founded in years of geotechnical engineering research, design, construction, and performance monitoring. These criteria are set and followed by the U.S. Corps of Engineers (1982a) and U.S. Bureau of Reclamation (1977) and serve as the design standards for State dam safety rules and regulations. The same standards also apply to soil and rock structures such as waste rock stockpiles, and cut and fill slopes.

Site Seismicity

The estimated Peak Ground Acceleration (PGA) of 0.22 g (Table 76) is sufficient to demonstrate the feasibility of providing dynamic stability in the layout and design of the tailings impoundment. The site seismicity would be re-evaluated during final design to ensure the estimated PGA is the most appropriate value for the Montanore site and for construction of a high-hazard dam. The PGA is the maximum rate of ground motion that will occur at a site. In MMC's analysis, PGA was based on occurrence of the maximum credible earthquake (Table 76).

MMC's estimated PGA value is the median (middle) probabilistic value obtained from several procedures used to estimate ground motion attenuation. The estimated PGA value is based on a given probability that a seismic event of a certain magnitude would occur at the site. If the probability of occurrence is changed, a new PGA is determined at the site. Generally, a higher probability of occurrence of an earthquake along a given fault results in a lower magnitude of earthquake and a lower PGA at the site. A deterministic PGA value (a selected PGA value based on the upper range of estimated ground accelerations regardless of the probability (percent chance) of the event occurring and impacting the site) may be more appropriate for the

Montanore tailings impoundment. This approach is consistent with seismic design guidelines for tailings dams (International Commission on Large Dams (1989) and the United States Committee on Large Dams (1999) (recommended design criteria by Klohn Crippen (2005)).

The design guidelines proposed by MMC (Klohn Crippen 2005) set the basis for a safe design and construction of the tailings impoundment. The references and agency guidelines cited by MMC, including the DNRC's dam safety regulations, do not provide specific standards with respect to seismic stability of large, high-hazard dams. The agencies' mitigation in Alternatives 3 and 4 would include incorporation of guidelines from other states, as appropriate, during final design.

Stability

MMC addressed the stability of the tailings impoundment dams through a series of minimum allowable safety factors against failure for static and dynamic loading conditions of the facilities (Klohn Crippen 2005). The factors of safety (FOS) for stability are summarized in Table 77. In addition, MMC completed a qualitative risk assessment of potential causes of failure of the tailings facility (Klohn Crippen 2005).

Included in the stability evaluation was a liquefaction analysis (the potential for a soil to act as a heavy fluid with little or no shear strength) to determine the locations of liquefiable or potentially liquefiable ground during the MCE of M7.0. The analysis was based on the number of hammer blows required to drive the soil sampler one foot (blow counts or 'n' values) obtained from Standard Penetration Tests (SPT) recorded during the different geotechnical field exploration work conducted in the Little Cherry Creek drainage basin. Under the Little Cherry Creek Tailings Impoundment Main Dam foundation area, the soils with SPTs that were found to indicate potentially liquefiable foundation materials are generally near the ground surface. The liquefaction assessment found that most of the foundation materials under the Alternative 2 tailings Main Dam are medium dense to dense. Only isolated pockets of material have the potential to liquefy during seismic loading with little or no impact on dam stability if left undisturbed during dam construction. Foundation materials under a portion of the Diversion Dam are loose to medium dense and could control the stability of the dam. The influence of the potential liquefaction zones was considered in the stability analyses for the Diversion Dam in Alternative 2 (Klohn Crippen 2005).

Liquefaction of the glaciolacustrine clay beneath the Main Dam foundation would be very unlikely due to the high fines content (*i.e.*, >30%). Large seismic events can be expected to generate elevated pore pressures in the clay and produce a short-term loss of strength following the seismic event (Klohn Crippen 2005). The location of a clay layer within the foundation beneath the right (south) abutment of the Starter Dam and its potentially low shear strength characteristics make the presence of the clay in the foundation a concern with respect to the design and stability of the tailings impoundment Main Dam. A portion of the clayey material would be excavated, stored within the disturbance area, most likely borrow areas, and backfilled with compacted fill to act as a "shear key" for stability (Figure 9). A shear key is an area excavated beneath the dam to enhance resistance against the dam sliding along a preferred plane or to increase shear resistance of material a circle failure plane would pass through and increase the FOS against slope failure. Based on preliminary design, up to three shear keys may be required under the final dam footprint. The extent of the glaciolacustrine clay and its strength would be assessed during final design to optimize the location and dimensions of the shear key to assure dam stability. Similar materials have not been identified in the foundation of the Poorman

tailings dam site, but geotechnical exploration is limited and would need to be expanded to confirm suitability of the dam foundation materials and stability of the dam.

Table 77. MMC Design Criteria and Calculated Values for Factor of Safety for Alternatives 2 and 4 Impoundment.

Loading Condition	Standard	Minimum Allowable Design Value	Calculated Value
Static Loading Condition	Limit-Equilibrium Factor of Safety (FOS)	FOS = 1.5 For operations and closure. FOS = 1.3 For end-of-construction conditions†.	2.06 1.8
Maximum Credible Earthquake (MCE)	Limit-Equilibrium FOS (Pseudo-static)	FOS = 1.15 For operating and end-of-construction conditions†.	1.34 1.17
	Displacements Estimated by Pseudo-Static Stability Analyses	Horizontal displacement of dam toe = 10 feet. Vertical settlement at the ultimate dam crest limited to less than 3 feet to prevent release of tailings.	2.5 to 10 feet Not Available
Post-Earthquake	Limit Equilibrium Factor of Safety	FOS = 1.1 Using residual strength in liquefied tailings and glaciolacustrine clay.	1.18
	Dynamic Deformation Analysis	Assessment using Makdisi-Seed, and Hynes-Griffith and Franklin empirical methods, as cited in Klohn Crippen 2005.	2 to 10 feet (horizontal)

†End-of-construction stability generally refers to completion of a compacted earthfill dam, not a cycloned sand dam as construction would be ongoing. Values reported are for cyclone dam at end of 5 years of operation. End-of-construction FOS for the compacted starter dam and saddle dams are not available.
Source: Klohn Crippen 2005.

The MCE earthquake estimated for the project site probably would not cause the tailings to liquefy and result in a catastrophic failure. As discussed in section 3.8, *Geology*, the tailings at the proposed Montanore Mine are likely to be similar to the tailings at the Troy Mine. The tailings at Troy were found to be dilatant (Knight-Piesold and Co. 2007). A dilatant material (also termed shear thickening) is one in which viscosity (commonly perceived as “thickness,” or resistance to flow) increases with the rate of shear.

MMC’s design criteria (Table 77) set the level of design effort and target FOS values as a measure of safety. Operational performance and dam safety depend upon on the quality of the geotechnical data and the correct application and use of industry accepted design procedures to complete the design and estimate the FOS. For this reason, thorough geotechnical field explorations and complete laboratory test programs are essential in achieving a safe dam structure. The more reliable the available data, the fewer and less conservative are the assumptions for unavailable or unknown design information. Data that is less reliable or available

increase the assumptions and the conservatism required to achieve a safe design. Based on the data presented by Klohn Crippen (2005), it has been demonstrated that a safe tailings dam structure could be constructed for Alternatives 2 and 4 with respect to meeting the minimum allowable FOS design criteria. Critical conditions have been evaluated and conservative assumptions have been made regarding foundation conditions and strength parameters.

Based on the stability analyses and estimated FOS values for the tailings impoundment dam, the Main Dam would be stable and not exhibit signs of distress or failure. The analyses presented by Klohn Crippen (2005) adequately demonstrate the feasibility of constructing and operating a stable tailings dam under Alternative 2. Additional geotechnical exploration and laboratory tests would be needed to address assumptions made in the preliminary design and confirm the stability of the dam. In Alternative 4, the seismic design parameters would be re-evaluated using more current data and evaluation procedures and the dynamic stability confirmed based on any revised parameters. In addition, circular failure plane assessments through the near-dam tailings and dam section and through the dam crest and slope would be completed during final design of the dam.

Tailings slurry deposition patterns used in operations of the impoundment can influence tailings facility stability: the impoundment capacity, and tailings particle size segregation, which can influence the tailings consolidation characteristics. These two issues are not high risk items and normally not an influence in demonstrating the feasibility of a project. For the Little Cherry Creek site, the issues become important due to limited space for dam expansion beyond that proposed. In addition, changes in dam height and dam configuration to increase the impoundment capacity would be critical as it affects other design issues, such as the material mass balance for the cyclone sand dam. Dam stability could be affected, should additional dam height be required to store the tailings. The issue of tailings deposition patterns, and settled density would be re-evaluated during final design.

Perimeter discharge of tailings slurry, as planned by MMC, typically results in tailings surfaces sloped downward into the impoundment area. This downward slope of the tailings reduces the available capacity at a given height compared to capacity calculated assuming level tailings deposition. The current height-volume relationship for the Alternative 2 tailings impoundment site is based on level tailings deposition in the impoundment, with some freeboard allowance for the slope of the tailings surface (Klohn Crippen 2007). The agencies' analysis indicates that the height of the dam to achieve the excess capacity would need to be slightly higher than the estimated dam crest by Klohn Crippen to compensate for the lost volume based on the sloped tailings deposition and the final tailings surface configuration proposed by MMC. This in turn would require a modification to the dam design and a re-evaluation of the dam stability. Final determination of the dam height versus impoundment capacity would be based on tailings deposition plans and the proposed final end-of-operation surface grading plan. The final dam height and dam configuration would be detailed during final design to confirm the appropriate dam height for use in the final stability analyses.

Tailings deposition patterns into the impoundment also influence the dam height and ultimate stability should the average settled density be less than estimated. Larger particles settle nearest the discharge point and finer particles settle farther out as the slurry flows away from the deposition point. Long travel distances from the point of deposition often result in particle segregation within the tailings impoundment, which typically results in a tailings mass that exhibits lower average settled densities and consolidation characteristics different from the tailings tested in the laboratory. Densities lower than estimated may require additional dam height

to provide the same storage capacity. Lower tailings densities may also impact the dam stability analyses when considering stability of the upstream section of the dam crest.

In the 1992 Montanore Project Final EIS, the issue of artesian ground water conditions beneath the Little Cherry Creek impoundment site was discussed. Artesian pressures at both impoundment sites (Little Cherry Creek and Poorman) were identified in some boreholes during the site investigations conducted by Noranda (Morrison-Knudsen Engineers, Inc. 1990). Noranda proposed to use a system of pressure relief wells to relieve artesian water pressures. In 1992, the agencies concluded an adequately designed pressure relief well system would relieve artesian pressure and ensure dam stability during all project phases. The agencies indicated a more conservative approach was needed during the initial construction and operation phase than that proposed in Noranda's conceptual design (USDA Forest Service *et al.* 1992).

MMC reviewed the hydrogeology and assessed the potential effects of the artesian pressures on the dam stability (Klohn Crippen Berger Ltd. 2008), and concluded:

- The stability of the downstream slope of the dam is controlled primarily by the soft glaciolacustrine clay, and the strength of the clay is controlled by the undrained shear strength
- The proposed downstream slope of the dam is flatter than the original design by Morrison-Knudsen
- The impoundment design includes an extensive underdrain system, which would limit the transfer of hydraulic head from the impoundment into the foundation soils
- Existing artesian pressures are not expected to become significantly higher due to impoundment construction and the artesian pressures would not affect the failure mode, including a failure plane through the glaciolacustrine clay
- The dam would be raised in stages over the life of the mine and piezometric pressures in the foundation would be monitored

The agencies concurred with MMC's conclusions regarding artesian pressures based on available data. The foundation design would be confirmed as part of the final design studies.

Failure Mode Effects Analysis

In addition to completing stability analyses to verify that the design criteria FOS would be met for the tailings dam, MMC completed a qualitative risk assessment using a modified Failure Mode and Effects Analysis (FMEA) process (Klohn Crippen 2005). 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. The term "risk" encompasses the concepts of both the likelihood of failure (the expected frequency of failure), and the severity of the expected consequences if such events occurred. FMEA seeks to characterize risks in a systematic way and is intended to identify the main risks or failure modes (McLeod and Plewes 1999). A FMEA reflects the information, judgment, and professional opinion available at the time it was performed (USDA Forest Service and DEQ 2001). Because predictive risk assessment involves foreseeing the future, it is an imprecise art (Robertson and Shaw 2003).

An assessment of likelihood and consequences of failure for construction, operations, and closure was made for each of the design and operational components. Three issues were included in the

FMEA related to the tailings dam stability: 1) increased pore pressure in glaciolacustrine clays resulting in lower FOS against dam/foundation failure; 2) unidentified liquefiable glacial outwash material in the dam foundation leading to reduced dynamic and post-earthquake FOS estimates; and 3) impoundment underdrains and/or the drains in the base of the cyclone sand dam became plugged and did not function on closure (Klohn Crippen 2005).

The FMEA was completed in a sequential manner by identifying the following:

1. Likelihood of failure quantified on a five-level scale based on an annual probability of failure/percent chance of occurrence (>50%, 10-50%, 1-10%, 0.1-1%, and <0.1%)
2. Consequences of failure ranked on a five-level scale (insignificant to catastrophic) for four areas (water quality, biophysical, community-social, and costs)
3. Level of confidence in the likelihood of failure and/or the consequences based on a three-level scale of high, moderate, and low
4. Compensating factors to reduce the risk for each failure mode and effect

The factors were compared and a Level of Risk was determined for each item. The Level of Risk ranged from Level 1 (completely unacceptable) to Level 5 (lowest level of risk). Each Level of Risk was identified by a pairing of likelihood of an occurrence with consequences of the occurrence. As the Level of Risk decreased, the possibility of occurrence/outcome pairings that resulted in that Level of Risk increased, as summarized below.

- Level 1 – A likelihood of “always certain” and “catastrophic” consequences
- Level 2 – Likely occurrence and catastrophic consequences to certain occurrence and major consequences
- Level 3 – Possible occurrence and catastrophic consequences to always certain likelihood and moderate consequences
- Level 4 – Unlikely occurrence and catastrophic consequences to always certain likelihood and minor consequences
- Level 5 – Conceivable but improbable occurrence and catastrophic consequences always certain occurrence and insignificant consequences

Of the 27 failure modes evaluated, six were judged to have a risk level of 4. The 21 other failure modes had risks levels of 5 or greater. One failure mode, loose glacial outwash material liquefied under seismic loading, leading to a reduction in factors of safety and dam failure, had an unlikely likelihood of occurrence, and catastrophic consequences (such material was not encountered or indicated as potentially present in the site in the existing site investigation data). The other five modes had greater likelihood of occurrence, but a minor to moderate consequences. Compensating factors for all failures modes for Alternative 2 are described in Klohn Crippen (2005).

3.9.3.2.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The lead agencies completed a stability evaluation of Alternative 3. The purpose was to confirm the feasibility to locate and design a stable Poorman Tailings Impoundment facility at a 120 million-ton capacity between Little Cherry and Poorman creeks.

Design criteria for minimum FOS values for static and dynamic loading conditions were the same as set for the Alternative 2 impoundment site. The PGA value for use in the pseudo-static analysis was assumed to be the same as Alternative 2. The two sites (Alternatives 2 and 3) are adjacent to one another and have similar foundation conditions. In addition, Alternative 3 borrow soils and cyclone sand foundation materials were assumed to be similar to the Alternative 2 materials; therefore, the Alternative 2 strength parameters were used in the stability analysis. In some cases, lower values were used in the analysis as a degree of conservatism because site-specific data for Alternative 3 are limited and Alternative 3 would be a critical facility to the project. The strength parameters for the tailings were slightly increased to a friction (phi) value equal to 20° because Alternative 3 tailings would be deposited as a high-density slurry resulting in a denser in-place product. Tailings placed as a high-density slurry generally show an increase in shear parameters over tailings placed at a lower slurry density (Klohn Crippen 2005).

The stability of the Alternative 3 tailings dam was evaluated using the slope stability computer program STABL developed at Purdue University. The use of the STABL program is widely accepted in the dam design/geotechnical industry as a suitable design tool, as is the program used by Klohn Crippen for the Alternative 2 stability analysis. Both programs incorporate the same methods of analyses in estimating the FOS of a slope. Several commercial software programs that incorporate the STABL program are available. The commercially available software XSTABL 5.0 was used to facilitate data input and view plots of the most critical surfaces (lowest FOS) determined in the analyses. Potential failure surfaces were searched for through-dam sections and tailings impoundment section and through the crest and near-dam tailings. In addition, the stability of the tailings slope deposited from the back of the impoundment and above the dam crest elevation was checked to assess the feasibility of placing the tailings in such a configuration. Based on the results of the analyses, the Alternative 3 tailings facility can be designed as a safe and stable structure under both static and pseudo-static loading conditions. Table 78 presents a summary of the results.

Table 78. Calculated Values for Factor of Safety for Alternative 3 Impoundment.

Case	Static FOS	Pseudo-Static FOS	Post-Earthquake FOS
Average Strength Parameters			
Cyclone Sand Dam Minimum allowable FOS	1.9 (1.5)	1.4 (1.15)	1.4 (1.1)
Upper Tailings Slope Minimum allowable FOS	- (1.5)	1.8 (1.15)	2.7 (1.1)
Reduced Strength Parameters			
Cyclone Sand Dam Minimum allowable FOS	1.5 (1.5)	1.1 (1.15)	1.3 (1.1)
Upper Tailings Slope Minimum allowable FOS	5.4 (1.5)	1.5 (1.15)	1.8 (1.1)

Source: Glasgow Engineering 2008.

The tailings deposited from the back slope and above the dam crest elevation would create the most critical situation for instability in Alternative 3. This situation was evaluated in the stability analyses completed for Alternative 3 (Glasgow Engineering 2008). Based on the results of the

analyses presented in Table 78, the proposed cyclone dam and tailings slope would be stable under static and pseudo-static loading conditions and post-earthquake strength reductions. In all but one case, the minimum FOS was met or exceeded in the analyses. The one case that did not meet the minimum was the pseudo-static analysis of the cyclone sand dam assuming reduced shear strength values. The estimated FOS was greater than 1.0 (*i.e.*, not indicating a likely slope failure), but was lower than the minimum allowable FOS. Impacts of failure of the tailings slope would be similar to liquefaction of the tailings slope as noted in the following paragraph.

Liquefaction potential of the tailings slope was not considered in the stability review. Recently deposited tailings would be subject to liquefaction. The volume of the liquefied mass is critical only if the available storage volume within the impoundment at the dam crest elevation were less than the volume of tailings liquefied and if all of the liquefied tailings moved down into the impoundment area. This would not be a critical issue until near the end of the Year 16 of operations. At the end of Year 16, mud wave action from the liquefied tailings and displacement of water stored in the impoundment could result in the breach of the dam. This potential for release of tailings from the impoundment may be the most critical situation related to Alternative 3. Such a failure mode has not been quantified but should be included in the final design of the facility. The primary mitigation measure would be increased dam freeboard above the storage level of the tailings. This situation would be most critical in the later years of operation, as it is possible that tailings would not be stored very far above the dam crest until after Year 10 of operations.

The issues of discharge patterns and tailings consolidation patterns related to the dam stability are less influential than as described under Alternative 2. The anticipated slope of the thickened tailings was considered in the conceptual layout of Alternative 3. Also, thickened tailings would not “flow” out into the impoundment in the same manner as slurried tailings. In-place particle segregation and changes in consolidation characteristics are typically not as critical with tailings deposited as slurry.

A FMEA specific to Alternative 3 was not completed. Based on the similarities of Alternative 3 with the Alternative 2 tailings impoundment regarding site conditions and design, results of a FMEA for Alternative 2 would be similar to those identified for Alternative 2. The risks of Alternative 3 associated with the dam safety would be neither different nor greater than those summarized for Alternative 2. Exceptions would be analysis of the tailings liquefaction potential discussed above. Provided these issues are properly addressed in the characterization of the tailings impoundment/dam design and the impoundment operations manual, the tailings liquefaction potential and impact would likely be considered a Level 4 or 5 risk.

3.9.3.3 Little Cherry Creek (Alternatives 2 and 4) and Poorman (Alternative 3) Tailings Site Comparison

This section presents a comparison of Little Cherry Creek (Alternatives 2 and 4) and Poorman (Alternative 3) tailings impoundment sites. The intent is to provide a summary of available data in each alternative in a comparative format. In general, the Poorman site was developed to avoid or minimize several environmental impacts of Alternative 2.

The primary technical difference in tailings disposal in Alternatives 2 and 3 is the method of tailings deposition used in each alternative. Alternative 2 is based on cyclone separation of the coarse fraction of the tailings for use in dam construction and typical slurry deposition of the finer fraction of the tailings into the impoundment area. Alternative 3 is based on cyclone separation of

the coarse fraction of the tailings for use in dam construction as in Alternative 2, and thickening the finer tailings slurry prior to deposition. The tailings would be thickened to increase the average in-place density of the tailings and reduce the required impoundment capacity.

The following sections present a comparison of the two alternatives based on data and information presented in Chapters 2 and 3, and MMC's Plan of Operations (MMI 2005a). The comparison is divided in technical issues identified during the analysis process of the two alternatives. The data for each issue are presented in a summary format with brief discussions provided only as needed to clarify the comparison.

3.9.3.3.1 Site Capacity and Expansion Potential Tailings Deposition

Tailings Production

- Alternative 2 – Primary and secondary cyclone for sand generation and use in dam construction; 55 percent slurry density deposited into impoundment from primary cyclone overflow. Direct deposition of secondary cyclone overflow into the impoundment. Tailings surface slope at 1 to 1.5 percent average.
- Alternative 3 – Primary and secondary cyclone for sand generation and use in dam construction; thicken slurry density of primary and secondary cyclone overflow to a 70 percent slurry density at deposition into impoundment. Tailings surface slope at 3 to 5 percent.

120 million ton Capacity Requirement

- Alternative 2 impoundment capacity is reported by MMC as 115 to 120 million tons for proposed tailings operations and a level tailings surface. Tailings discharge patterns into the impoundment have not been configured for sloped tailings and is subject to reduction of total capacity at the proposed dam crest elevation. The net capacity has not been confirmed at 120 million tons.
- Alternative 2 Tailings Deposition – Slurry tailings at 55 percent solids by weight with an average density at the end of operation of 75 pcf (pounds per cubic foot). Deposition of thickened tailings was not considered necessary unless final design studies showed higher density tailings were required to maintain the proposed dam and impoundment footprint.
- Alternative 3 capacity is 120 million tons for the proposed tailings operations and tailings deposition from a higher elevation along the back of the impoundment. Sloped surfaces and proposed closure surface used to confirm total site capacity. The impoundment site was evaluated for capacity assuming a level tailings surface. The site would require an additional 5 feet of dam height for thickened tailings deposition at 85 pcf (based on level tailings surface and not accounting for water management in the impoundment.
- Alternative 3 Tailings Deposition – Thickened tailings at 70 percent solids by weight with an average settled density of 85 pcf. Deposition of slurry tailings at 55 percent solids by weight was not considered practical for the total capacity as it would require an additional 15 feet of dam height. The ability to achieve these densities is discussed in the following *Operation Flexibility and Impoundment Expansion Potential* section.

Dam Construction

- Alternative 2 – Requires a Starter Dam, a North Saddle Dam, a ridge line South Saddle Dam later raised with cyclone sand, and a Main Dam constructed with cyclone sand (Figure 8).
- Alternative 3 – Requires a Starter Dam, a Rock Toe Berm to anchor toe area of main sand dam, an earthfill Saddle Dam, and a Main Dam constructed with cyclone sand (Figure 26).

Foundation Conditions and Borrow Material

- Alternative 2 – Foundation conditions generally good except that glaciolacustrine clay in Main Dam foundation potentially affects dam design. A portion of the clay would be excavated and backfilled with compacted fill to act as a shear key for stability. High ground water level in Main Dam area. Sufficient borrow materials available within facility footprint and adjacent areas. Granular materials available through commercial sources. The volume of cyclone sand available for dam construction per year based on yearly production rates versus required volume of sand to raise the dam annually to maintain adequate storage capacity in the impoundment area has not been generated to date by MMC.
- Alternative 3 – Foundation conditions generally good and similar to Alternative 2. Glaciolacustrine clay may not be present in foundation; additional geotechnical investigations would be required. High ground water level in Main Dam area. Sufficient borrow materials available within facility footprint and adjacent areas. Granular materials available through commercial sources. The volume of cyclone sand available for dam construction per year based on yearly production rates would meet required volume of sand to raise the dam annually to maintain adequate storage capacity in the impoundment area based on the proposed dam layout and impoundments operations. The annual dam volumes were interpolated from dam sections generated from raises at 40-foot height increments.

Seepage Control

- Alternative 2 – Seepage control in Alternative 2 would be provided primarily by collection drains in the impoundment and the dam foundation. The estimated seepage loss is 25 gpm into the foundation footprint. Additional design components to reduce seepage losses would include an increased density of the impoundment drainage system, a pumpback well system between the dam and Seepage Collection Pond, or a deeper cutoff trench below the starter dam and under the saddle dams. Seepage interception would be facilitated by the cross-valley dam design. Seepage interception would be more difficult south of the South Saddle Dam, which would be immediately adjacent to the Diversion Channel.
- Alternative 3 – Seepage control in Alternative 3 would be similar to the Alternative 2 design for seepage control. It is assumed that the average seepage loss would be about 25 gpm as in Alternative 2. The potential for additional seepage control is similar to Alternative 2 and would employ the same alternatives. Due to the wide footprint of the dam and the assumed underlying foundation geology, the occurrence of unacceptable foundation seepage below the dam would not likely be through isolated or confined zones in the foundation. The Poorman Impoundment Site would require a broader layout of the collection system. In addition, there would be less room downstream of the dam footprint to install a pumpback well system or other

seepage interception systems between the dam toe and private property not owned by MMC.

Operation Flexibility and Impoundment Expansion Potential

- Alternative 2 – Upsets in daily operations such as pump failures and surges in the tailings system could likely be handled or accommodated without problems or threat of breach due to excess water. An operating plan would address occurrences such as excess water build up or reduction in available cyclone sand. Generation of tailings slurry at 55 percent by weight is common. Less dense slurry deposition could occur due to improper design of the thickener or pumping system, temporary upsets in operations or improper operation practices. Such upsets are expected to be infrequent and short-term and should not affect the operation (water balance and storage capacity) of the impoundment. Expansion of impoundment capacity beyond the proposed layout would require modifications in the design and construction of the dam crest. The perimeter area for extending the toe of the dam and continuing raises per design to increase capacity is very limited beyond the proposed footprint. Potential alternatives for dam crest raises would include over-steepening the downstream slope in subsequent raises or designing a modified upstream raise of the crest.
- Alternative 3 – Upsets in the tailings thickeners and in daily operations would require an operating plan to accommodate short periods of conventional slurried tailings deposition within the site. Such occurrences could be handled and include short-term increases in water within the impoundment. The system required to thicken fine tailings to a slurry density of 75 percent has not been determined. The Montanore ore body consists of hard, unaltered rock that would be crushed to a fine-grained non-plastic material, which is generally amendable to thickening without the use of filters. The thickening system best suited for Montanore tailings would be determined before final design of the site was initiated. Once a system was determined feasible, the potential for upsets would be minimized and limited to infrequent and short-lived upsets as in Alternative 2. In the event it is demonstrated that the tailings could not be thickened in a reasonable manner, the suitability of Alternative 3 tailings facility would have to be re-evaluated and compared to Alternative 2. Expansion of impoundment capacity beyond the proposed layout would require modifications in the original design or in the design and construction of the dam crest some time after operations began. The perimeter area for extending the toe of the dam and continuing raises per design to increase capacity is limited beyond the proposed footprint. Potential alternatives for dam crest raises would include over-steepening the downstream slope in subsequent raises or designing a modified upstream raise of the crest. Depending upon the characteristics of the thickened tailings, upstream deposition patterns and discharge elevations could also be modified to increase storage capacity.

Based on these comparisons, both alternatives have equally positive as well as limiting attributes and characteristics. The single significant difference between the two alternatives appears to be the ability to deposit the finer fraction of the tailings as a slurry at 55 percent solids by weight in Alternative 2 versus the likely necessity for the deposition of the fine tailings as a thickened tailings at 75 percent solids by weight in Alternative 3. A secondary difference is that the storage capacity in Alternative 2 has not been confirmed relative to deposition patterns and the preferred tailings surface configuration at closure. The capacity in Alternative 3 was based on deposition

patterns and a final tailings surface configuration. Another secondary difference between the alternatives is the potential for additional seepage control once in operation. Alternative 2 site conditions are likely better suited for the installation of remedial facilities for seepage control and collection than in Alternative 3. Due to the deposition of thickened tailings in Alternative 3, there is less water available to contribute to or result in unacceptable seepage losses. Additional design studies are required for both alternatives prior to identifying a preferred alternative based on technical comparisons such as those presented above. The difference in expansion potential for the two sites is negligible, based on the available data and site layouts.

3.9.3.4 Cumulative Effects

None of the reasonably foreseeable future actions would result in cumulative effects of subsidence risk or impoundment stability with the Montanore Project.

3.9.3.5 Regulatory/Forest Plan Consistency

This section is not applicable to geotechnical engineering.

3.9.3.6 Irreversible and Irretrievable Commitments

This section is not applicable to geotechnical engineering.

3.9.3.7 Short-term Uses and Long-term Productivity

This section is not applicable to geotechnical engineering.

3.9.3.8 Unavoidable Adverse Environmental Effects

Some roof failure would occur in all action alternatives.

Draft Environmental Impact Statement for the Montanore Project

Volume II

Chapter 3: Affected Environment and Environmental Consequences, Section 3.10, Ground Water Hydrology through Section 3.25, Other Required Disclosures

Chapter 4: Consultation and Coordination

Other Chapters: Index, Acronyms, Glossary, and References



Cabinet Mountains *Photo by M. Holdeman*

United States Department of Agriculture
Forest Service
Northern Region
Kootenai National Forest

Montana Department of Environmental Quality

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3.10 Ground Water Hydrology

Ground water occurs in fractures of the bedrock formations beneath the analysis area and in unconsolidated glacial and alluvial sediments along and adjacent to drainages throughout the analysis area. Although hydraulically connected in many areas, the two water-bearing materials behave differently because of their respective hydraulic characteristics.

3.10.1 Regulatory Framework

3.10.1.1 Permits and Authorizations Held by MMC

Noranda submitted a "Petition for Change in Quality of Ambient Waters" in 1989 to the BHES requesting an increase in the concentration of select constituents in surface and ground water above ambient water quality, as required by Montana's 1971 nondegradation statute. Supplemental information to support the petition was submitted by Noranda in 1992. In response to Noranda's petition, the BHES issued an order in 1992, authorizing degradation and establishing nondegradation limits in surface and ground water adjacent to the Montanore Project for discharges from the project (BHES 1992). The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, zinc in both surface and ground water, nitrate (ground water only), and total inorganic nitrogen (surface water only) (Table 79; Appendix A). These nondegradation limits are discussed in section 3.10.1.2.2, *Nondegradation Regulations*. The Order remains in effect for the operational life of the project and for as long as necessary thereafter. The Order also indicates that treatment using land application and disposal as then proposed, and currently proposed in Alternative 2, would satisfy the requirement in ARM 16.20.631 (3) (now ARM 17.30.635 (3)) to treat industrial wastewaters using technology that is the best practicable control technology available, or, if such technology has not been determined by the EPA, then the equivalent of secondary treatment as determined by the DEQ. In 1992, the DHES (now DEQ) determined that land application and disposal treatment, with at least 80 percent removal of nitrogen, would satisfy the requirements of ARM 16.20.631(3). The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved. The Order also adopted the modifications developed in Alternative 3, Option C, of the Final EIS (1992), addressing surface and ground water monitoring, fish tissue analysis, and in-stream biological monitoring.

3.10.1.2 Applicable Regulations and Standards

3.10.1.2.1 State Standards

Montana's water quality rules classify all ground waters in the analysis area as Class I, which are suitable with little or no treatment for public and private drinking water supplies, culinary, and food preparation purposes, irrigation, drinking water for livestock and wildlife, and commercial and industrial purposes. Montana water quality standards for inorganic pollutants pertinent to the project are shown in Table 79.

3.10.1.2.2 Nondegradation Regulations

The Montana Water Quality Act requires the DEQ to protect high quality state water from degradation. The current nondegradation rules were adopted in 1994 and apply to any activity resulting from a new or increased source that may degrade a high quality water. These rules do

not apply to sources, such as the Montanore Project, that received an authorization to degrade prior to the adoption of the 1993 amendments to Montana's nondegradation statute.

Table 79. Nondegradation Limits Established by BHES Order for the Montanore Project and Montana Surface Water Quality Standards.

Parameter	BHES Order Maximum Allowable Nondegradation Limits (mg/L)	Montana Ground Water Quality Standards (mg/L)
pH	—	6.5 – 8.5
Total dissolved solids	200	—
Nitrate + nitrite, as N	10	10
Dissolved Metals		
Antimony	—	0.006
Arsenic	—	0.01
Cadmium	—	0.005
Chromium	0.02	0.1
Copper	0.1	1.3
Iron	0.2	—†
Lead	—	0.015
Manganese	0.05	—†
Mercury	—	0.002
Nickel	—	0.1
Selenium	—	0.05
Silver	—	0.1
Zinc	0.1	2

"—" = No applicable concentration.
mg/L = milligrams per liter.
†The concentration of iron or manganese must not reach concentrations that interfere with the uses specified in the surface and ground water standards (ARM 17.30.601 *et seq.* and 17.30.1001 *et seq.*). The Secondary Maximum Contaminant Level of 0.3 mg/L for iron and 0.05 mg/L which is based on aesthetic properties such as taste, odor, and staining, may be considered as guidance to determine the levels that will interfere with the specified uses.
Source: BHES Order 1992 (Appendix A), Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2008.

3.10.2 Analysis Area and Methods

3.10.2.1 Analysis Area

The ground water analysis area includes all areas around the proposed mine facilities: mine, adits, LAD Areas, and tailings impoundment sites. The transmission line would not affect ground water and is not discussed further in this section. The analysis area (model domain) for a ground water model developed by the lead agencies includes a large area around the facilities, bounded by U.S. 2 to the east, Bull River and Clark Fork River on the west and southwest, Big Cherry Creek to the north, and Silver Butte Fisher River to the southeast. The model domain is depicted in Figure 69.

3.10.2.2 Baseline Data Collection

Ground water data from monitoring wells in the Little Cherry Creek and Poorman Tailings Impoundment Sites, and LAD Areas, and adit portal areas were collected annually between 1988 and 1995 (Geomatrix 2006c). The sampling frequency varied from one to multiple times per year.

Limited bedrock ground water data were collected in the area overlying the ore body during an exploration drilling program in the 1980s. Exploration data included notations of observations of ground water in core holes and depth to water in those core holes that encountered ground water. Additional bedrock ground water data were collected by Noranda between 1990 and 1998 prior to sealing of the Libby Adit. The adit data included water discharge records, detailed descriptions of fractures and faults encountered by the adit, and ground water quality (Geomatrix 2006c).

Considerable ground water data were collected in the Little Cherry Creek Tailings Impoundment Site, including distribution of ground water heads, aquifer characteristics of the various hydrostratigraphic units, and water quality (Geomatrix 2006c). Several monitoring wells and boreholes were installed in the area of the Poorman Tailings Impoundment Site in 1988 (Chen-Northern 1989). The wells and boreholes were used to define ground water flow direction and subsurface geology and one well was tested to determine hydraulic conductivity. This information was supplemented with a resistivity survey. Water samples were collected from wells in the Poorman Tailings Impoundment Site between 1988 and 1993 and analyzed for most major cations and anions and total dissolved solids.

Validation ground water quality data were collected by MMC from two monitoring wells installed in 2005, one in the Little Cherry Creek Tailings Impoundment Site and one near the proposed LAD Areas (Geomatrix 2006c).

With the exception of the validation sample results, all of the ground water hydrology data were collected prior to 2003. The data are basic information and are representative of current conditions. There may be slight changes in depth to ground water due to seasonality or longer climate cycles, but the basic ground water flow directions have not changed. The aquifer characteristics measured in the 1980s and 1990s would not change within the timeframe of the project. Ground water quality may vary slightly, but validation samples collected from two locations by MMC in 2005 confirmed that ground water quality has not changed appreciably.

3.10.2.3 Impact Analysis

3.10.2.3.1 Montanore Mine Area Hydrology

Because ground water hydrology data from the proposed mine area are limited, the agencies used a numerical ground water model to evaluate various aspects of proposed conceptual models to define a consistent conceptual model that could be used to evaluate potential impacts to the mine area ground water hydrology. A complete description of the model, including assumptions, results, and calibration is provided in the Hydrogeology Technical Report (ERO Resources Corp. 2008b).

A hydrogeology committee consisting of representatives from the KNF, DEQ, MMC, and ERO was established to guide the development of the agencies' numerical model. The agencies' conceptual model was modified as the numerical analysis progressed, as described below. The agencies' numerical model was initially constructed using the following assumptions regarding a conceptual model for the Montanore mine area:

- Metasedimentary rocks in the mine area have very low primary permeability (hydraulic conductivity).
- Fractures and other structures provide pathways for ground water movement.
- Fracture or secondary permeability is higher than primary permeability.
- Source of ground water is infiltration of precipitation.
- Static water levels measured in exploratory boreholes (in those containing water) were at an elevation of about 5,400 to 5,600 feet.
- Springs consistently start at an elevation of about 5,400 to 5,600 feet. Springs that occur above this elevation are probably the result of isolated shallow flow cells controlled by local fracturing, bedding planes, or drainage from surficial material such as colluvium or talus.
- Base flow to streams and springs is maintained by ground water discharge. Perennial flow in area streams begins at an elevation of about 5,400 to 5,600 feet. (Base flow is the flow of a perennially flowing stream without any direct surface water runoff; such flow is the result of ground water seepage into the stream channel. During the driest portions of the year when there is no surface runoff either from snowmelt or rain, the only flow in a perennial stream is base flow.)
- A ground water table exists at depths up to 500 feet below ground surface in the higher topographic areas and is at or near land surface in areas below elevations of 5,400 to 5,600 feet.

For the mine area, the hydrologic data used to calibrate the model were:

- Empirical information concerning elevation of springs and the start of perennial streamflow (at an elevation of 5,400 to 5,600 feet) (USGS 1983; Wegner, pers. comm. 2006b)
- Measured flow from the Libby Adit (steady state flow of 150 gpm) (Geomatrix 2006a)
- Steady state flow from the Heidelberg Adit in the East Fork Rock Creek drainage (Figure C-2 in Appendix C) (45 to 135 gpm) (it is assumed that 45 gpm represents base flow to the adit and the higher flows represent periods of increased shallow ground water flow) (Gurrieri 2001)
- Measured base flows in streams at the edges of the model domain

Because there were insufficient site data to support a three-dimensional model, the agencies used a two-dimensional model to perform the analysis. Although the numerical precision of this two-dimensional model is limited by the relatively small amount of field data available for calibration, the model was configured to take advantage of the availability of a wide range of observation and measurement types (including streamflow data, location of perennial springs, and limited ground water information from exploration boreholes). In addition to calibrating the agencies' numerical model, the predicted base flow in East Fork Rock Creek was compared to observed streamflow in September 2007. The field comparison indicated that the model-predicted values for base flow in the upper reach of East Fork Rock Creek were similar to observed streamflow during a period of base flow.

The inherent uncertainties in the agencies' numerical model are not sufficiently large to preclude the model's ability to predict reasonable values of base flow and changes to base flow under mine dewatering conditions. The uncertainties prevent the agencies' numerical model from predicting exactly where ground water drawdown and the resulting decrease in base flow would occur. Most of the uncertainties in the agencies' numerical model are due to the model's inability to simulate the heterogeneous conditions of the fractured system. The likely location of reduced base flow can be deduced where there is sufficient field information concerning the location of bedrock springs and saturated fractures.

The two-dimensional model does not permit the inclusion of detailed geologic layers. As such, ground water within surficial material along the streams, such as alluvium, colluvium, and glacial deposits, cannot be directly simulated. The numerical model simulated the likely contribution of the surficial deposits to base flow by using varying infiltration rates (as a function of slope). During the agencies' field review of upper East Fork Rock Creek in September 2007, very little surficial material was observed at the higher, steeper elevations. The surficial material observed at the higher elevations is relatively thin. As a result, it is unlikely that this material can store significant volumes of ground water for discharge to streams during late summer/early fall when base flow is the primary contributor to streamflow (Gurrieri, pers. comm. 2007; MMC 2006). This specific condition was observed during the September 2007 field review. In the lower elevation areas, surficial material can be hundreds of feet thick and likely contributes ground water to streams late in the season.

Although the model does not simulate ground water in thick sequences of surficial material, the selection of infiltration rates to match measured base flows indirectly accomplishes the simulation. The higher infiltration rate used for lower elevations probably compensates for the higher permeability material not directly included in the model. If the lower elevations were only composed of bedrock, the infiltration rate would be lower and the base flow also would be lower. To calibrate with measured base flows, the infiltration rate had to be increased in these areas.

The area of study (model domain) is based on the maximum area potentially affected by mine-induced changes in the ground water hydrology, as determined by the agencies' numerical ground water model. The two tailings impoundment sites and LAD Areas are included within the model domain, but were not specifically modeled with respect to their proposed operation in the mine-area two-dimensional model. Three scenarios were modeled: pre-mining, mining, and post-mining conditions.

3.10.2.3.2 Little Cherry Creek Tailings Impoundment Hydrology

MMC developed a ground water model of the Little Cherry Creek watershed using the two-dimensional finite element program Seep/W (Klohn Crippen 2005). The Seep/W program models mounding of the ground water beneath water retention structures such as tailings impoundments and changes in pore-water conditions within earth slopes due to infiltration. The agencies independently performed SEEP/W analyses, using the same geologic and hydrologic model developed by MMC (USDA Forest Service 2008a). The ground water model assumed four stratigraphic units:

- An upper glaciolacustrine layer with the lowest in-situ hydraulic conductivity (0.01 ft/day) that was not continuous in lateral extent

- A lower glacial till layer that was also not continuous in lateral extent and had higher hydraulic conductivity (0.1 ft/day) than the overlying glaciolacustrine layer but lower than the underlying fractured bedrock
- A fractured bedrock layer with the highest relative hydraulic conductivity (0.3 ft/day) that was assumed to be the primary aquifer in the Little Cherry Creek drainage
- A less fractured, hard bedrock stratum with very low hydraulic conductivity (0.03 ft/day)

The agencies and MMC both used the same hydrologic and geologic boundary conditions, which assumed a constant precipitation infiltration of 0.26 feet/year, basin elevations of 4,750 feet at the head of the watershed, 3,110 feet at the confluence of Little Cherry Creek and Libby Creek, and constant head at the surface of the tailings. Neither MMC's nor the agencies' modeling incorporated a pumpback well system, which likely would be necessary to intercept seepage not captured by the underdrain system.

Analyses were performed assuming a baseline or predevelopment condition, and then assuming various tailings elevations within the tailings dam throughout the life of the project. Tailings elevation ranged from 3,500 feet (top of the starter dam) to elevation 3,700 feet (maximum tailings elevation). The agencies performed analyses at various elevations to determine if different tailings elevations affected seepage rates. Analyses also were performed at the final tailings elevation of 3,700 feet to estimate the effects of drain under the tailings dam on seepage, and then the effects of drains under both the tailings and the tailings dam, as proposed by MMC.

3.10.2.3.3 Ground Water Quality

Potential changes in ground water quality were assessed by developing estimates of expected wastewater quality that would be discharged to ground water, such as seepage from an impoundment and water applied to the LAD Areas. Mass balance calculations were performed at the impoundment sites and LAD Areas, mixing the applied water with the existing or ambient conditions, including ground water flux and ground water quality to estimate the likely final ground water quality. The agencies' approach to the mass balance calculation, the expected wastewater quality, and the uncertainties associated with the mass balance calculations are discussed in section 3.11.2, *Analysis Area and Methods* in section 3.11, *Surface Water Hydrology*. Ambient concentrations used in the analysis are representative of the concentrations found at each assessed area: the Little Cherry Creek Impoundment Site, the Poorman Impoundment Site, and the LAD Areas (Table 81 in section 3.10.3.5, *Ground Water Quality*). No data were available for antimony in the Poorman Impoundment Site; antimony concentrations from the Little Cherry Creek Impoundment Site were used in the Alternative 3 analysis. For the mine area water quality analysis, hydrologic principles were used to evaluate likely changes to ground water quality as a result of dewatering the mine void and adits.

3.10.3 Affected Environment

3.10.3.1 Bedrock Hydrogeology

3.10.3.1.1 Hydrogeologic Framework

Bedrock in the mine area consists of metamorphosed sediments known as the Belt Supergroup. The sediments were originally deposited as a series of muds, silts, and sands, subsequently metamorphosed to argillites, siltites, and quartzites, respectively. The primary porosity and

permeability of the bedrock is very low, as a result of the metamorphic process. The primary hydraulic conductivity may be as low as 10^{-11} cm/sec (2.8×10^{-8} ft/day) with virtually zero primary effective porosity. All bedrock units are fractured and faulted to various degrees, depending on proximity to large fault structures and depth. Fractures and faults result in secondary hydraulic conductivity and secondary porosity values that are much higher than primary hydraulic conductivity values. Secondary hydraulic conductivity may range from 10^{-4} to 10^{-6} cm/sec (0.0028 to 0.28 ft/day) (Gurrieri 2001). Various estimates of the bulk hydraulic conductivity (which considers both the primary and secondary hydraulic conductivities) have been made (Gurrieri 2001; Klohn Crippen 2005; Geomatrix 2006c). The agencies' numerical model of the site hydrogeology was calibrated using a bulk or average hydraulic conductivity of the bedrock in the mine area of about 10^{-7} cm/sec (ERO Resources Corp. 2008b).

The Rock Lake Fault bounds the western side of the mine area and extends northwest and southeast through the mine area. The fault is a major structure with as much as 1,500 to 2,000 feet of vertical displacement (USGS 1981). The agencies' numerical ground water model was used to explore the fault's role in the site area hydrogeology. Based on the model results, the average or bulk hydraulic conductivity of the fault zone is estimated to be slightly higher than that of the bedrock (2.5×10^{-5} cm/sec (7×10^{-2} ft/day)) (ERO Resources Corp. 2008b). The fault zone may contain zones or fractures with higher hydraulic conductivities. The model results indicate that if these zones exist, they are not horizontally extensive because the fault zone does not appear to play a major role in the regional hydrogeology.

The hydraulic conductivity of fractures and joints tends to decrease with depth, due to confining pressures of the rock reducing the fracture apertures (Snow 1968). In brittle crystalline rock (such as the Belt Supergroup); however, fracture apertures can be maintained to considerable depths, as evidenced by inflows during the construction of the Libby Adit and by reports of ground water inflows from numerous deep hardrock mines around the world. This is particularly true when fractures are associated with large structures, such as the Rock Lake Fault (Galloway 1977).

The geologic logs of exploration boreholes drilled into the mine area indicate that a thin layer of highly weathered bedrock or overburden (such as colluvium) exists over much of the higher topographic areas. This layer ranges in thickness from 0 to 50 feet and averages 36 feet thick.

As is typical for mountainous areas, the ground water table generally follows topography. A water level contour map for the mine area cannot be constructed because water level data were limited. Available data and observations suggest a water table exists within much of the mine area. For example, the depth to water was measured in a few of the exploration boreholes (HR-19 and HR-26) with a consistent water surface elevation of about 5,400 to 5,600 feet (Chen-Northern 1989). The depth to water in exploration boreholes adjacent to Rock Lake (HR-7, 8, 9, and 10) and St. Paul Lake (HR-29) was the same elevation as the lake (Chen-Northern 1989). Several borehole logs did not report a depth to ground water or report encountering ground water. Based on observation, springs and perennial portions of streams generally start at elevations of 5,400 to 5,600 feet (USGS 1983; Wegner, pers. comm. 2006b). The depth to water measurements and site observations indicate that a water table exists at a depth of about 500 feet below land surface in the higher areas, and near or at the surface in areas below an elevation of about 5,400 to 5,600 feet. A September 2007 site review by the agencies located a perennial bedrock spring in the East Fork Rock Creek drainage at an elevation of 5,625 feet, slightly above the estimated range of 5,400 to 5,600 feet. This spring likely derives its flow from the fractured bedrock, based on the

geology and spring characteristics, and its elevation is considered to be within the estimated range for intersection of the water table with the ground surface.

3.10.3.1.2 Conceptual Model of the Mine-Area Bedrock Hydrogeology

A hydrogeologic conceptual model is a commonly used tool for extending knowledge beyond what is specifically known and allowing the predictions or estimates of what the hydrogeologic system's response might be if conditions change in the future. For a hydrogeologic conceptual model to be useful, it must be internally consistent and explain most, if not all, observations or known facts. A model that is not internally consistent cannot be confidently used to predict responses to changes in conditions. The following sections discuss two conceptual models of the site hydrogeology. The two models use the same basic geologic framework, but arrive at different conclusions regarding the hydraulic connection between deeper ground water, shallow ground water, and surface water.

MMC's Conceptual Model

MMC's conceptual model has ground water flow in the mine area divided into three general flow paths: (1) regional deep flow in bedrock; (2) local shallow flow in upper weathered and fractured bedrock; and (3) local shallow flow in surficial unconsolidated deposits (Geomatrix 2007c, 2007d). Ground water in these flow paths moves from higher to lower elevations. The deeper regional flow path is characterized by low hydraulic conductivity fractures, faults, and bedding planes that convey ground water from recharge areas at high elevations to areas of low elevation along the flanks of the Cabinet Range. Very little, if any, ground water moves through the unfractured rock matrix.

The shallow flow paths are characterized by localized recharge and discharge through near-surface fractured and weathered bedrock, fine-grained glacial lake beds (glaciolacustrine) of silt and clay, and poorly sorted glacial outwash deposits (glaciofluvial) of gravel, sand, silt, and clay. Shallow ground water also flows in alluvial deposits of sand and gravel that occur in many of the valleys of the Cabinet Range (Geomatrix 2006d).

The Cabinet Mountains are composed of hard, brittle metasedimentary rocks with complex fracture systems that can store and transport ground water (Geomatrix 2006c). Glacial deposits mantling the flanks of the mountains support shallow ground water systems. Valleys with streams draining the mountains contain unconsolidated colluvial and alluvial deposits that also support local ground water systems. In general, most ground water is recharged at higher elevations and moves downhill in both shallow and deep bedrock systems. The deep regional ground water moves down to the valleys where some of the water discharges to the glacial and valley fill deposits. Some of this water also discharges to streams and springs in the analysis area. MMC reports that most ground water in the deeper fractures discharges to surface flow systems below an elevation of about 4,000 feet and is not well connected hydraulically to lakes, streams, and springs above 4,000 feet near the proposed mine (Geomatrix 2007d, 2008e).

During mine development and the mining period, ground water would flow into the adits and mine void. The inflow rate of 1,200 gpm used by MMC for assessing storage and discharge requirements likely would be a maximum inflow rate that may occur during relatively short-term dewatering of fractures. Except for short-term elevated inflow rates from initial dewatering of fractures, the steady-state long-term inflow rates for the mine and adits are estimated to be 600 to 800 gpm (Geomatrix 2007c). For the post-operational period, ground water intercepted by the mine workings would fill the mine workings. MMC anticipates no long-term discharge would be

expected from the adits because the Libby Adit has had no discharge since 1998 and the adit would be plugged at closure. When the Libby Adit was reopened in 2006, ground water within the adit was observed to be discharging to colluvium exposed within the adit near the portal. The adit seepage probably flowed through the colluvium to the Libby Creek alluvium. MMC anticipates that there would be immeasurable impacts to base flow during mining or after because much of the water flowing into the mine void would be from storage, and the deeper ground water system is not well connected to surface water bodies near the proposed mine (Geomatrix 2007d, 2008e).

Agencies' Conceptual Model

The agencies' conceptual model is based on the following key components of the hydrogeologic framework:

- Metasedimentary rocks in the mine area have very low primary permeability (hydraulic conductivity)
- Fractures and other structures provide pathways for ground water movement
- Fractures or secondary permeability is higher than primary permeability

The source of all surface and ground water in the Cabinet Mountains is precipitation that falls within the mountain range. No regional aquifers beneath the range derive their source of water from outside the range. Ground water (shallow and deep) results from infiltration of precipitation at various rates, depending on the topography and geologic material exposed at the surface. Due to the topographic relief, occurrence of more permeable surficial geologic deposits and low overall hydraulic conductivity of the bedrock, different ground water flow paths have developed in shallow unconsolidated deposits and the deeper fractures of the bedrock. At the higher elevations (greater than about 5,600 feet), the surficial deposits are non-existent or relatively thin and discontinuous, but they store and discharge infiltrated precipitation over the course of a year. In typical or dry precipitation years, it is likely that all ground water drains from these deposits by the end of the season. In wetter years, ground water may not fully drain by the end of the season. The net infiltration rate to deeper fractures in the steeper bedrock terrain is probably very low, as most precipitation would leave the area as runoff. The shallower, more fractured or weathered portions of the bedrock probably receive and transmit water at higher rates than the deeper fractures.

The contrast between the very low hydraulic conductivity of the deeper fractured bedrock and the higher hydraulic conductivity of the shallow weathered bedrock/surficial deposits and infiltration rates between the shallow and deeper fractured bedrock (and surficial material) appears to result in two saturated zones with distinctly different flow characteristics. The shallow and deeper flow paths do not appear to be hydraulically connected above an elevation of about 5,600 feet. There is probably ground water leakage from the shallow weathered bedrock/surficial deposits at low rates into unsaturated bedrock or randomly saturated vertical fractures that eventually reaches the deeper fractured bedrock flow path. Site observations during the exploration program, elevation of where streams become perennial, and field observations concerning the location of springs indicate that a water table has developed in interconnected fractures at a depth of about 500 feet below the areas of highest elevation. The water table slopes toward the valleys and intersects the low areas at an elevation of about 5,400 to 5,600 feet, about the same elevation that streams become perennial (Figure 70). Springs exist above and below 5,400 to 5,600 feet elevation range; springs above this elevation are part of the shallow flow path and springs below this elevation are

connected to both flow systems. Below an elevation of between 5,400 and 5,600 feet, there are two distinct flow paths due to very different hydraulic conductivities, but the two flow paths are hydraulically connected.

Base flow, defined as the volume of flow in a stream channel that is not derived from surface runoff but rather from ground water seepage into the channel, is maintained in the upper reaches of each drainage by deeper bedrock fractures during the driest part of each year. In the middle and lower reaches of the drainages, it is difficult to separate that portion of the "apparent" base flow resulting from the deeper system versus from shallow ground water. In the lower, flatter areas, ground water from thicker surficial deposits accounts for a much higher contribution to base flow than in the higher areas. During the year, there is probably an ever-changing ratio between shallow ground water and deeper bedrock ground water contributions to any one stream, as the season progresses. Depending on when precipitation starts in the fall, it may not be possible to know if or when a stream reaches true base flow, particularly with the limited available flow data for streams in the analysis area.

The agencies' field review of the East Fork Rock Creek drainage during the driest season (September 2007) indicated that the only surface water flow in East Fork Rock Creek above Rock Lake was from discharge of ground water from bedrock springs. During the review, there was no surface water runoff or evidence that shallow springs maintained by snowmelt and/or recent rainfall contributed any water to the drainage. At least one small spring was flowing down a bedrock wall near St. Paul Pass; the source of the spring's water was probably a small snowfield high on Rock Peak. It appeared that the spring water was consumed by evapotranspiration and never reached the Rock Creek drainage. Precipitation records from the SNOTEL site near Bear Mountain, Idaho, indicate that the summer of 2007 had the second longest period (51 days) without precipitation since continuous precipitation data collection began in 1983. Bedrock springs from the Rock Lake fault zone along the East Fork Rock Creek drainage above Rock Lake accounted for 100 percent of the flow in the stream, which was estimated at 30 to 40 gpm. Ground water discharge to the stream started at an elevation of about 5,625 feet. At the time of the field review, bedrock ground water appeared to be the sole source of water to Rock Lake. Streamflow gradually increased downstream from an estimated 40 to 50 gpm below Rock Lake to an estimated 1 cfs (480 gpm) within 0.5 mile and 2 cfs before the stream enters Rock Creek Meadows. These observations are consistent with the agencies' conceptual model that deeper bedrock ground water is connected to shallow ground water and surface water at elevations below about 5,600 feet.

Of the two conceptual models (MMC's and agencies'), the agencies' conceptual model is the more conservative with respect to predicting potential impact to ground and surface water resources in the mine area. In addition, the agencies' conceptual model is better supported by site data and observations. Therefore, the remainder of this section uses only the agencies' conceptual model as the basis for discussion and analyses of the affected environment.

3.10.3.2 Valley-fill Hydrogeology

Ground water occurs in the valley-fill deposits in narrow mountain valleys. These deposits contain colluvial, alluvial, and glacial materials in a heterogeneous mixture of clay, silt, sand, and larger-sized particles. Valley-fill deposits follow the valley bottoms, are not extensive, and are discontinuous because bedrock crops out along the stream channel bottoms. Geophysical surveys indicate the valley-fill deposits are 30 to 70 feet thick at the Libby Adit Site, and 24 to 70 feet

thick at the Ramsey Plant Site. Ground water was encountered during drilling at depths of 12 to 16 feet at the Libby Adit Site and at 22 feet at the Ramsey Plant Site.

The valley-fill systems are recharged by precipitation, streamflow, and subsurface discharge from bedrock ground water systems. Ground water flow follows the topography down the valley bottoms. The valley-fill discharges to surface water or to more extensive glaciofluvial and glaciolacustrine deposits along the mountain front.

3.10.3.3 Glaciofluvial-glaciolacustrine Hydrogeology

In both tailings impoundment sites, the Libby Plant Site, and the LAD Areas, ground water occurs either as perched water, water table, or artesian conditions in unconsolidated glaciofluvial and glaciolacustrine deposits. The glacial deposits form a wedge along the eastern flank of the Cabinet Mountains, beginning at an elevation of about 4,000 feet and increasing in depth away from the mountains. The deposits range in thickness from zero at bedrock outcrops near the Little Cherry Creek Impoundment Site to over 200 feet thick in the Poorman Tailings Impoundment Site, based on apparent resistivity (Chen-Northern 1989).

The glaciofluvial and glaciolacustrine deposits are interfingered (a boundary that forms distinctive wedges, fingers or tongues between two different rock types) and, at many locations, glaciolacustrine deposits overlie glaciofluvial deposits. The glaciolacustrine deposits are finer-grained and act as a barrier to ground water flow. In the Little Cherry Creek Tailings Impoundment Site, a buried preglacial valley underlies the glaciolacustrine deposits. This valley is filled with over 275 feet of fluvial sediments similar to the glaciofluvial deposits.

The glaciofluvial/glaciolacustrine ground water system is recharged by precipitation, discharge from fractured bedrock, and streamflow along the flank of the mountains. Ground water flow in both potential impoundment sites is generally easterly following the surface topography (Figure 72). The potentiometric surface gradient (hydraulic gradient) is low in both the Little Cherry Creek and Poorman Tailings Impoundment Sites (0.05 and 0.07, respectively). Ground water flow in the Little Cherry Creek Tailings Impoundment Site is generally easterly following the surface topography, discharging to Little Cherry Creek and eventually to the alluvium of Libby Creek. Some flow may discharge to Libby Creek via the deep buried alluvial channel. Ground water beneath the Poorman Tailings Impoundment Site also flows easterly following topography and discharges to the alluvium of Libby Creek. A map showing ground water elevations is presented in Chen-Northern (1989), and includes areas of potential artesian flow beneath the right embankment of the proposed Little Cherry Creek Tailings Impoundment Main Dam. Some of the water flowing beneath the Little Cherry Creek Impoundment Site discharges as springs in the proposed dam site area and downstream along Little Cherry Creek. Springs also were found in the Poorman Tailings Impoundment Site (see section 3.10.3.4, *Springs and Adits*).

Ground water in the LAD Areas discharges to Ramsey, Poorman, or Libby creeks. Based on depth to ground water data and general hydrologic principles, ground water beneath the LAD Areas flows toward the three creeks (Ramsey, Poorman, and Libby) that border the LAD Areas. Of the wells established in the LAD Areas, one exhibited artesian heads above the ground surface. Based on the available ground water data, the hydraulic gradient in the LAD Areas is about 0.06.

Aquifer tests were conducted in the glaciofluvial deposits and in the filled channel in the tailings impoundment sites. The hydraulic conductivity of the glaciofluvial deposits in the Little Cherry

Creek watershed ranges from 1 x 10^{-6} to 1.9 x 10^{-3} cm/sec (0.0028 to 5.3 ft/day) (Geomatrix 2006c). Estimates of the hydraulic conductivity of channel fill (alluvium along Libby Creek) ranges from 0.053 to 0.18 cm/sec (150 to 500 ft/day) (Geomatrix 2006c). In the Poorman Tailings Impoundment Site, the hydraulic conductivity of the glaciofluvial deposits range from 1.3 x10^{-4} to 6.8 x 10^{-3} cm/sec (0.37 to 19.4 ft/day) and average 2.6 x 10^{-3} cm/sec (7.35 ft/day), based on six aquifer tests (Chen-Northern 1989).

The glaciofluvial deposits are capped by relatively impermeable glaciolacustrine units. These deposits allow hydraulic pressures to build and create the confined or artesian flow conditions observed in the Poorman and Little Cherry Creek Tailings Impoundment Sites. The water levels observed in monitoring wells at the tailings impoundment sites are quite variable, ranging from beneath the bedrock-soil contact to above the ground surface, indicating artesian conditions along the lower portions of the valleys. It is not known whether the low permeability fine-grained material in the Poorman Tailings Impoundment Site are the same glaciolacustrine type deposits found in the Little Cherry Creek drainage, but they appear to function in the same manner.

Hydraulic conductivities of the glaciolacustrine deposits in the Little Cherry Creek Tailings Impoundment Site range from 1 x 10^{-6} to 2.6 x 10^{-5} cm/sec (0.003 to 0.075 ft/day) (Geomatrix 2006c). Although saturated, the fine-grained glaciolacustrine deposits did not yield measurable water in the boreholes. No aquifer tests were performed on the fine-grained deposits in the Poorman Tailings Impoundment Site. The range of hydraulic conductivity values in this area is probably similar to those measured in the Little Cherry Creek drainage.

3.10.3.4 Springs and Adits

3.10.3.4.1 Mine Area Springs

Springs in the analysis area are located in the unconsolidated surface deposits left by glaciers or occur at surface expressions of fractures and faults. Numerous springs were identified in the analysis area by MMC (Geomatrix 2006a, 2006d, 2007f). Other nearby springs and seeps outside of the analysis area, but within the upper Ramsey and Libby creek watersheds, have not been surveyed (Wegner, pers. comm. 2006b). Five springs in the CMW were identified by MMC, two south of Rock Lake, two near the north end of Rock Lake, and one near St. Paul Pass (Figure 71, Table 80). These springs are relatively small, discharging less than 4 gpm. Other springs in the analysis area (Table 80) originating from colluvium or bedrock discharge at higher rates (4 to 50 gpm).

It is likely that there are unidentified springs that have not been inventoried due partly to the steep terrain, forest cover, and size of the area. Also, the agencies' September 2007 field review identified springs overlying the mine area not previously mapped (SP-31, Figure 71). The DEQ reported spring discharge in a drainage above St. Paul Lake (SP-32, Figure 71) along the trace of the Rock Lake fault at an elevation of about 5,400 feet, slightly lower than the spring observed in the East Fork Rock Creek drainage (McKay, pers. comm. 2007). During normal to dry years when winter snows have completely melted, deeper ground water discharge may be the only source of water to St. Paul Lake during late summer to early fall. Spring SP-32 has not been observed during the late summer so it is uncertain whether this spring contributes water to St. Paul Lake during the late summer season. Because St. Paul Lake is located on a relatively permeable glacial moraine, the lake is reported to be completely dry during extended periods of low or no precipitation. This indicates that either the lake drains at a faster rate than input from ground water or the lake does not receive ground water input during the late season.

Table 80. Spring Flow Measurements and Elevations.

Spring Name	Elevation (feet amsl)	Flow Rate (gpm)
Springs in Libby Creek Watershed		
SP-01	3,500	2-3
SP-02	3,320	1-2
SP-10	3,350	1
SP-11	3,370	0.5
SP-12	3,390	seep
SP-13	3,410	unknown
SP-14	3,350	0.2
SP-15	3,420	1.5-2
SP-17	3,560	0.5
SP-18	3,550	2
SP-19	3,950	9
SP-20	3,850	<1-4
SP-21	3,800	<3
SP-22	4,240	<3
SP-23	3,680	<5
SP-24	3,450	<3
SP-25	3,840	5
SP-26	3,320	0.5
SP-27	3,840	2
SP-28	3,500	4
SP-30	3,420	5
Springs in CMW		
SP-1R	4,900	1 (Oct) - 10 (July)
SP-2R	4,850	1 (Oct) - 10 (July)
SP-4R	6,490	5-20
SP-05/3R	4,200	5-30 (100 in summer 1999)
SP-16	4,600	40-50
SP-31	5,625	30-50 (Sept 2007)
SP-32	5,400	Unknown

amsl = above mean sea level.
gpm = gallons per minute.
Source: Geomatrix 2006a, 2006d, 2007f; McKay, pers. comm. 2007; September 2007 agencies' field review of Rock Lake area.

The source of water to springs in the analysis area is ground water from either fractured bedrock or from unconsolidated deposits. Based on the agencies' conceptual model and the results of the agencies' numerical model, springs at elevations greater than about 5,600 feet (or greater than 5,625 feet) overlying the ore body are most likely associated with a shallow ground water flow path in weathered bedrock, glacial or alluvial deposits, or shallow fractures or bedding planes. Spring flow from bedrock fractures connected to the deeper ground water flow path cannot be ruled out, but no direct data supports this possibility. Springs located below an elevation of about 5,600 feet are also the result of discharge from shallow weathered bedrock or glacial/alluvial deposits, but because the shallow and deeper flow paths are most likely hydraulically connected,

some component of the total spring flow may be from the deeper flow path. The ratio between deep and shallow ground water probably varies from spring to spring and may vary seasonally.

The existing spring inventory overlying the ore body did not identify the source of ground water associated with each particular spring. A field review during September 2007 indicated that spring SP-05/3R, uphill from the Heidleberg Adit in the East Fork Rock Creek drainage, most likely has a bedrock ground water source. There was insufficient thickness of surficial material above the spring to support an estimated discharge rate of 30 to 40 gpm during a period of little to no precipitation. A previously unidentified spring or a series of springs along East Fork Rock Creek above Rock Lake at an elevation of up to 5,625 feet produced a total flow of about 40 to 50 gpm from the fracture zone associated with the Rock Lake fault. There is insufficient thickness or extent of surficial material above the springs to account for this flow rate during a dry period. Also, the stream bed above the spring consisted of exposed bedrock (no alluvium) indicating that there was no surface water or shallow ground water contribution to the springs from higher elevations.

3.10.3.4.2 Impoundment/LAD Area Springs

Most identified springs in the Libby Creek watershed occur in the Little Cherry Creek and Bear Creek drainages, or the Poorman Tailings Impoundment Site between Little Cherry Creek and Poorman Creek. All of the identified springs have measured flows of less than 5 gpm, except for the spring near the Libby Adit that was measured at 9 gpm. Some of these springs cease flowing in mid- to late-summer. The following descriptions (from 1988 to 2007) correlate to springs shown on Figure 71 and Figure 72 (Table 80).

3.10.3.4.3 Adits

The 700-foot long Heidelberg Adit, located in the East Fork Rock Creek drainage below Rock Lake, discharges water to East Fork Rock Creek. During a geotechnical evaluation of the Heidelberg Adit (Morrison-Knudsen 1989b), ground water flow in the adit was estimated to be 80 gpm. Gurrieri (2001) reports adit flows ranging from 49 to 128 gpm. Discharge from the adit appears to vary seasonally, suggesting the flow may be a combination of shallow and deep ground water. The shallow ground water contribution to the adit is more responsive to seasonal changes in precipitation. During September 2007, the estimated flow from the adit was between 40 and 50 gpm.

3.10.3.5 Ground Water Quality

Ground water samples from monitoring wells in the tailings impoundment sites and LAD Areas show that existing ground water quality is a calcium bicarbonate or calcium-magnesium bicarbonate type with low total dissolved solids concentrations (averaging 125 mg/L in the LAD Area, 92.4 mg/L in the Little Cherry Creek Tailings Impoundment area, and 118 mg/L in the Poorman Tailings Impoundment area) and frequently non-detectable dissolved metals. Manganese, cadmium, chromium, and copper were the only metals consistently detected in ground water samples. The pH of the water is near neutral or slightly acidic in the various project areas (Table 81).

Table 81. Existing Median Ground Water Quality.

Parameter	LAD Area Wells			Little Cherry Creek Impoundment Area Wells			Libby Adit Area Wells			Poorman Impoundment Area Wells		
	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL
Field Measurements and Physical Parameters												
Field Temperature (C)	8	45	0	8	51	0	8	114	0	8	18	0
Field pH (s.u.)	6.5	47	0	7.2	51	0	6.0	100	0	7.4	18	0
Lab SC (µmhos/cm)	81	51	0	179	51	0	58	99	0	185	18	0
Total dissolved solids	85	51	0	99	51	0	<44	105	3	102	18	0
Cations and Anions												
Alkalinity, Total as $CaCO_3$	40	51	0	87	51	0	5	109	0	94	18	0
Alkalinity, Bicarbonate as HCO_3	49	51	0	106	51	0	6	109	0	115	18	0
Chloride	<2	51	16	<1	51	29	<1	109	53	<1	18	10
Sulfate	<5	51	18	<4	51	21	<5	109	16	<2	18	9
Calcium	7	51	0	<19	51	1	<5	109	5	24	18	0
Magnesium	<3	51	3	7	51	0	<1	109	41	8	18	0
Potassium	<1	51	18	<1	51	18	<1	109	53	<1	18	7
Sodium	<6	51	4	5	51	0	<4	109	14	<2	18	3
Nutrients												
Nitrate + Nitrite, as N	<0.49	56	6	0.10	51	0	<2.20[†]	135	2	0.07	18	0
Dissolved Metals												
Antimony	<0.003	6	6	<0.003	6	6	NM	0	0	NM	0	0
Arsenic	<0.005	51	51	<0.005	51	50	<0.005	100	99	<0.005	18	17
Cadmium	<0.0002	51	30	<0.001	51	36	<0.001	103	81	<0.001	18	13
Chromium	<0.004	51	48	<0.02	51	45	<0.02	103	103	<0.02	18	18
Copper	<0.001	51	32	<0.01	51	44	<0.01	103	97	<0.01	18	18
Iron	<0.05	51	36	<0.05	51	39	<0.05	103	100	<0.05	18	15
Lead	<0.001	51	42	<0.01	51	50	<0.01	103	102	<0.01	18	17
Manganese	<0.04	51	21	<0.03	51	20	<0.02	103	86	<0.02	18	16
Mercury	<0.0002	51	49	<0.0002	51	48	<0.0002	103	80	<0.0002	18	14
Silver	<0.0002	51	51	<0.001	51	50	<0.001	103	102	<0.001	18	18
Zinc	<0.02	51	29	<0.02	51	38	<0.02	102	71	<0.02	18	14

Conc. = concentration; No. Samples = number of samples analyzed for particular parameter; No. BDL = number of analyzed samples with concentrations below the detection limit; detection limit varied between sample events and parameter; detection limit used in calculating median when reported concentration was below the detection limit
All values are in milligrams per liter (mg/L) unless noted in first column.
s.u. = standard units; µmhos/cm = micromhos/centimeter; C = Celsius; < = less than concentration shown; NM = analyte not measured.
[†]Nitrate concentrations at Libby Adit area wells affected by Noranda's discharges.
Source: Geomatrix 2007f.

Limited information is available on bedrock ground water quality. Noranda collected samples of inflow water from the Libby Adit and MMC collected an additional sample in 2006 (Geomatrix 2006c). Noranda sampled a bedrock spring (SP-16) near the Heidelberg Adit in 1989 and concentrations of all analytical parameters were very low, with all metals except molybdenum below the detection limit (Chen-Northern 1990).

3.10.3.6 Ground Water Use

No ground water users have been identified in the analysis area. Private land immediately downgradient of the Little Cherry Creek Tailings Impoundment Site in Alternatives 2 and 4 is owned by MMC. Private land immediately downgradient of LAD Area 2 in all alternatives and downgradient of the Poorman Impoundment Site in Alternative 3 is not owned by MMC.

3.10.4 Environmental Consequences

3.10.4.1 Alternative 1 – No Mine

The No Mine alternative would not change ground water levels or quality. Monitoring wells installed as part of the baseline monitoring would be removed and the area reclaimed. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Disturbances at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals.

3.10.4.2 Alternative 2 – MMC's Proposed Mine

3.10.4.2.1 Mine Area

Ground Water Levels and Flow

In all action alternatives, the mine plan would include an underground mine and three adit declines. The mine void would be the same in all action alternatives. In Alternative 2, two adits would originate in the Ramsey Creek drainage, and the existing Libby Adit would be used for ventilation. The mine and adits would intersect saturated fractures and faults in the bedrock and, therefore, would produce ground water at various rates. The water, called mine and adit inflows, would be pumped from underground structures and used for processing the ore. Another ventilation adit that would reach the surface near Rock Lake was not specifically considered in the numerical model because any ground water drawdown resulting from the ventilation adit would be superseded by drawdown created by inflow to the mine void.

Possible environmental consequences to the hydrogeology due to Alternative 2 would be expressed in two ways: lowering of ground water levels and changes in base flow. The agencies' numerical model was used to approximate where and to what degree ground water drawdown could occur, and to estimate changes in base flow for drainages flowing from the area to be mined.

Drawdown – Mining Period

In the agencies' numerical model to simulate dewatering of the mine void, the water table overlying the mine void was lowered (1,000 meters or about 3,300 feet) to the elevation of the

mine void at full build out of the mine. This simplifying assumption is necessary because of the use of a two-dimensional numerical model. Using this assumption, drawdown due to mine dewatering is predicted to extend about 2 miles from the mine void in all directions, but along the trend of the proposed adits, drawdown created by the mine void would merge with drawdown created by the adits (Figure 73). Given uncertainties described in the technical report (ERO Resources Corp. 2008b), the model cannot precisely predict the final configuration of the drawdown cone around the mine, but the model does provide an indication of the catchment area required to supply the predicted 450 gpm to the mine and adits on a steady state basis. If steady state inflow to the mine were higher, a larger catchment would be required to supply that water at the calibrated infiltration rates and hydraulic conductivity. For example, if the steady state inflow were in the range of 800 gpm estimated by MMC (Geomatrix 2007c), the catchment area would be about two times larger than predicted by the agencies' numerical ground water model, using the assumptions inherent in the model.

An example of the uncertainty in the agencies' numerical model is the final shape of the drawdown cone, due to the assumption in the agencies' numerical model that homogeneous conditions exist in the mine area. As a result of this assumption, the numerical model essentially distributes potential impacts from mine dewatering evenly in all directions. The site conditions may vary and ground water drawdown may be subject to some degree of heterogeneity, causing more drawdown along structural trends and less drawdown in other directions. Data are insufficient for the model to predict heterogeneous drawdown. Another example of uncertainty is the location of the 3-foot (1-meter) drawdown contour (assumed to represent zero drawdown) presented in the various figures in this document. The specific shape of the 3-foot (1-meter) contour is subject to influence by the size and location of the various elements used in the agencies' numerical model. To some extent, model elements control the geometric shape of the contours. Given the approximate nature of the agencies' numerical model, the location of all contours, including the 3-foot (1-meter) contour, should be considered approximate.

For those areas where the fractured bedrock water table is currently some depth below ground surface (for all areas above 5,600 feet elevation), ground water drawdown, as predicted by the agencies' numerical model, would not have a direct effect on surface water occurring above this elevation. Because surface and ground water above 5,600 feet elevation appear not to be hydraulically connected, ground water drawdown would not result in decreases to surface water (streams, springs and lakes) in those areas. Infiltration of precipitation is controlled by the nature of the surface material and overall hydraulic conductivity and, therefore, the infiltration rate would not change in these areas as a result of a lower water table. It is possible that random fractures exist above elevations of 5,600 feet that are saturated between the fractured bedrock water table and the shallow ground water flow path, hydraulically connecting the two ground water flow paths. If this condition existed, drawdown of the fractured bedrock water table by mine dewatering could reduce flow to unidentified springs or affect lake levels associated with this type of fracture, such as the Libby Lakes. However, there are no observations, data or numerical model results to indicate this condition exists.

For those areas where ground water is either at the surface or connected hydraulically to shallow ground water flow systems (below an elevation of about 5,600 feet), drawdown due to mine dewatering would decrease the volume of water available to the surface water system, such as springs, lakes and streams. In the agencies' conceptual model, ground water and surface water are hydraulically connected below elevations of about 5,600 feet and, therefore, surface water would

be affected if ground water levels decreased due to mine dewatering (see sections 3.10.4.2.1 and 3.10.4.3.1, *Mine Area* for a discussion of potential impacts to surface water).

Drawdown – Post-mining Period

The agencies' numerical model was used to perform a transient analysis to estimate the time required for the ground water drawdown created by mine dewatering to fully recover to pre-mining levels or to steady state water levels below pre-mining water levels. Using a reasonable value for effective porosity, the results of the analysis indicated that the area would require slightly more than 20 years to recover to steady state water level conditions after the mine void was filled with water (ERO Resources Corp. 2008b). Based on an estimated inflow rate of about 450 gpm and estimated volume of the final mine void, the mine void would require about 50 years to refill. Ground water levels above the mine void are predicted to return to steady-state conditions about 70 years following mine closure and plugging of the portals. While water levels were recovering, the ground water flow direction in the region would be predominantly toward the mine void and adits and any change in base flow to streams would occur for much of this recovery period. Any change in ground water contribution to streams would decrease through the recovery period as the ground water head in the mine void increased and flow toward the mine void decreased (see *Changes in Base Flow* section below).

Mine/Adit Inflow

The agencies' numerical ground water model predicted that the total steady state inflow to the mine and adits at full build out would be about 450 gpm (for the fault scenario). The extent of the agencies' numerical model-predicted drawdown is based on inflows to the mine and adits within this range of steady state inflows. The calculated reduction in base flow to streams is also based on this range of steady state inflows. The 1992 Montanore Project Final EIS used steady state inflow of 1,200 gpm, based on estimates developed by Noranda Minerals Corp. (USDA Forest Service *et al.* 1992). MMC used a steady state inflow of 1,200 gpm in developing a project water balance (MMI 2005a, MMC 2008), but reduced steady state inflow to 800 gpm after additional analysis (Geomatrix 2007c).

Blasting during development of the adits and mine void and the presence of a mine void may result in stress redistribution that could affect local ground water flow in fractures around the mine and adits. The stress redistribution may open some fractures and close others, depending on the actual stress regime. It is unlikely this would result in a net change in the steady state inflows to the mine and adits. It is possible that changes to the fracture network resulting from the stress redistribution could affect (increase or decrease) drawdown beneath local areas and alter inflow to specific portions of the mine void and adits, but it is not possible to predict if or where this may occur.

Changes in Base Flow

The effects of ground water drawdown due to dewatering of the mine can be best expressed by estimating changes to base flow in streams. As part of the agencies' numerical model calibration process, the model results were compared to measured flows considered to be base flow in various streams that drain the area. In general, streamflow measurements were from gaging stations located on the periphery of the agencies' numerical model domain (Figure 69). Flow data from the upper reaches of the various streams are insufficient to quantify base flow at these locations. Because the model was calibrated to flow data at the periphery of the model domain and to several other direct observations, including the elevation at which streams tend to become

perennial, the model's base flow predictions at various locations along the streams are considered reasonable estimates. The model results are also based on the assumption that the predicted base flow is representative of a typical precipitation year. The agencies' numerical model predicted base flow values for the various model nodes that are comparable to the $7Q_{10}$ values calculated for several locations along various streams (see section 3.12.2, *Analysis Area and Methods*). A subsequent field review in September 2007 confirmed that base flows in the upper reaches of East Fork Rock Creek (above and just below Rock Lake) were similar to those predicted by the agencies' numerical model (see section 3.10.3.1.2, *Conceptual Model of the Mine-Area Bedrock Hydrogeology*).

Base flow for the three periods (pre-mining, mining, and post-mining) were modeled for nodes along four streams (Libby, Ramsey, and Rock creeks, and East Fork Bull River) using the agencies' numerical model (ERO Resources Corp. 2008b). Using these base flows as existing condition, the changes in flow were calculated for each model node along the streams for the mining and post-mining periods (ERO Resources Corp. 2008b). The same process was used for the cumulative analysis that included both the Rock Creek and Montanore mines (ERO Resources Corp. 2008b).

Several factors should be considered in evaluating the significance of this analysis. In many cases, the predicted changes at any given location may appear to be small compared to typical streamflows and measurement precision. For example, the model predicts changes in the upper reaches of Libby Creek of between 0.02 and 0.04 cfs for the mining period. The predicted changes in base flow at this location are about 10 percent of the model-predicted base flow. It is unlikely that such changes could be measured or detected for two reasons. First, it is difficult to measure streamflow to an accuracy greater than plus or minus 10 percent, within the range of typical flows of streams in the mine area using a streamflow meter (Wegner, pers. comm. 2007). Flow measurement error could be reduced to less than plus or minus 5 percent with the use of a flume or weir in low flow situations. Second, uncertainty in year-to-year base flow at the gaging station locations would result in a significantly higher range of values than the predicted changes. Professional judgment was used to evaluate the changes predicted by the agencies' numerical model (ERO Resources Corp. 2008b).

To estimate the duration of the predicted base flow reduction, the agencies examined the relative contribution of ground water base flow and surface water runoff to a given stream. There are very few streamflow data from the upper reaches of most streams draining the CMW. It is likely that during non-base flow periods, streamflows are probably much greater than the base flow period, but the actual flows are unknown. The agencies reviewed the hydrograph from three stream locations (Granite Creek and Flower Creek, located near Libby, Montana, and Boulder Creek, near Leonia, Idaho) where between 22 and 50 years of continuously recorded annual flow data exist. Based on these three streams, it appears that streams in the area flow at base flow for about 1 to 2 months between mid-July to early October. The stream hydrographs indicate that periods of base flow also may occur during November through March, but these base flow periods were not included in the base flow estimate of 1 to 2 months.

Libby and Ramsey Creeks

The agencies' numerical model-predicted changes in base flow in Libby and Ramsey creeks are small compared to the likely variability in determining base flow at any one location. Model-predicted changes in base flow of fractions of a cubic foot per second may occur due to mining,

but the predicted changes in base flow for the four upstream-most nodes in Libby Creek are low enough that it is unlikely changes of this magnitude would be measurable. Any reduction in base flow due to mine dewatering would persist for about 70 years after mine closure as the mine void refilled to steady-state conditions.

If total mine/adit inflow were not adequate to supply water for process purposes, MMC would likely install ground water wells for make-up water. MMC has not identified specific well locations; the most likely location would be along a major drainage, such as Libby Creek. The amount of make-up water required would depend primarily on mine inflows and precipitation at the impoundment site. MMC estimated 133 gpm would be needed on a steady-state basis if mine inflows were 800 gpm. If the numerical modeled inflows of 450 gpm were representative of actual inflows, 483 gpm of make-up water would be needed. Ground water withdrawals from Libby Creek alluvium would result in ground water level decreases near the pumping wells while the wells are in operation. Because of the relatively high hydraulic conductivity of the alluvium and the hydraulic connection with the active stream, ground water levels in the alluvium would be expected to fully recover soon after pumping ends. Potential impact on streamflow is discussed in section 3.11, *Surface Water Hydrology*.

Rock Creek

The agencies' numerical model-predicted base flow for the upper reaches of East Fork Rock Creek (above and below Rock Lake) is consistent with streamflow observed during a September 2007 site visit. In September 2007, no surface runoff or shallow ground water was contributing to the stream. All of the observed flow was from deep bedrock ground water discharge to the drainage. The flow rate out of Rock Lake was similar to the flow from East Fork Rock Creek above the lake. The agencies' numerical model predicted that changes in base flow due to mine inflow would reduce the deeper ground water contribution to East Fork Rock Creek above the lake to near zero (ERO Resources Corp. 2008b). The predicted changes would result in no flow into Rock Lake if base flow were the sole contribution of surface flow into Rock Lake, such as during late summer to early fall.

There may be some annual variability in base flow along the upper reaches of East Fork Rock Creek, but the variability is probably small compared to the predicted flow reductions (ERO Resources Corp. 2008b). About 0.75 mile below Rock Lake, East Fork Rock Creek enters a flat area with a considerable thickness of alluvium (Rock Creek Meadows). There is likely sufficient water storage in the alluvium to mask any potential reductions in base flow at this location and downstream. In other words, changes in base flow above Rock Creek Meadows predicted by the model would likely be measurable, but changes at or downstream of Rock Creek Meadows would not likely be measurable.

East Fork Bull River

The same effects predicted in the upper reaches of East Fork Rock Creek are predicted by the agencies' numerical model for the upper reaches of the East Fork Bull River drainage. The DEQ reported spring (SP-32) discharge in a drainage above St. Paul Lake near the trace of the Rock Lake fault at about 200 feet lower in elevation than the spring observed in the East Fork Rock Creek drainage (McKay, pers. comm. 2007). During normal to dry years when winters snows have completely melted, deeper ground water discharge may be the only source of water to St. Paul Lake during late summer to early fall. Spring SP-32 has not been confirmed to flow during late summer base flow period, so it is uncertain whether this spring contributes water to St. Paul

Lake during the late summer season. Because St. Paul Lake is located on a relatively permeable glacial moraine, the lake is reported to completely dry during extended periods of low or no precipitation. This indicates that either the lake drains at a faster rate than input from ground water or the lake does not receive deep ground water input during the late season.

Model-predicted reductions in base flow in the upper reaches of East Fork Bull River (above St. Paul Lake) may be a large portion of the total base flow (ERO Resources Corp. 2008b). Impacts may not be measurable when precipitation and/or remaining snow pack continue to be a source to spring and streamflow above the lake, but in drier years, impacts from mining may aggravate natural low-flow conditions. Because of the fluctuating nature of St. Paul Lake, any reduction in base flow above St. Paul Lake may not be measurable. Like Rock Creek, if the thickness of the alluvium along East Fork Bull River increased downstream of St. Paul Lake, there may be sufficient water storage in the alluvium to mask any potential reductions in base flow.

Based on the agencies' numerical model results, reduced base flow would persist during the post-mining period for a portion of the drainage until the mine void was refilled with water and the regional water table recovered. After the regional water table recovered, the agencies' numerical model predicts there would be a slight increase in ground water contribution to portions of the East Fork Bull River compared to pre-mining conditions (ERO Resources Corp. 2008b).

Base Flow Changes With 800-gpm Inflows

The previous discussion of changes in base flow is based on the agencies' numerical model, which predicted total steady state mine and adit inflows of 450 gpm. MMC estimates a steady-state inflow of 800 gpm in a revised water balance for the mine operation (Geomatrix 2008a). If the steady state inflows were 800 gpm, then the reduction in streamflow would be about two times higher than predicted by the agencies' numerical model. Using a total inflow rate of 800 gpm would not affect the changes in base flow predicted by the agencies' numerical model during the post-mining period (ERO Resources Corp. 2008b).

Summary

The agencies' numerical model predicted base flow at various locations along streams draining the mine area. The model did not consider what is possible to detect or measure. Other factors should be considered when reviewing and interpreting predicted base flow. For example, base flow at any one location along a stream may not be easily defined within the range of the model-predicted changes, but impacts from dewatering of the mine and adits may be expressed in other ways, such as changing the elevation at which streams begin to flow. Mine dewatering (and resultant ground water drawdown) may cause this elevation to move down the drainage.

Another consideration in the ability to measure or detect changes in base flow due to mine dewatering is the annual variability in precipitation. In wet years, there may be sufficient precipitation and/or remaining snowpack to mask any changes in base flow that would otherwise be observable in late summer to early fall. Also, in the middle to lower reaches of the various drainages, sufficient thicknesses of alluvium or other surficial deposits have the ability to store sufficient ground water. Ground water discharge from these deposits through the dry period would probably be sufficiently high to mask any changes in base flow resulting from mine dewatering. An example of this condition is at Rock Creek Meadows, located about 0.75 mile downstream from Rock Lake.

In contrast to the middle and lower reaches of the various streams, the upper reaches in the higher elevation portions of these drainages have either no alluvium or much thinner alluvium or other surficial deposits with limited ground water storage capacity. Late season base flow, which typically begins at elevations of 5,400 to 5,600 feet, is derived mostly from deeper ground water and may be subject to measurable changes from mine dewatering.

Another consideration in determining whether surface water would be affected by mine dewatering is to what degree the hydrogeology of the area is heterogeneous versus homogeneous. The agencies' numerical model assumed homogeneous conditions because of the lack of specific data on this issue. If the ground water flow system were controlled by structural trends, reduction in base flow may be focused in one or more of the drainages along structural trends, rather than being distributed as predicted by the model. It is not possible to predict how this condition might affect base flow with the currently available data. Ground water monitoring in piezometers drilled from within the mine adits and/or mine void would provide information on the degree of heterogeneity of the fractured bedrock system that could be used to refine model observations.

Springs and Seeps

Based on the results of the agencies' numerical model, ground water drawdown would occur around the mine as a result of dewatering of the mine void and adits. Flow from springs hydraulically connected to the deeper ground water flow path (below an elevation of about 5,600 feet (or 5,625 feet in the case of East Fork Rock Creek) would be reduced. Because springs located below an elevation of about 5,600 feet may derive their water from both shallow and deep ground water flow paths at various ratios, it is not possible to predict the amount (if any) of flow reduction. Also, there are little spring flow data for use in determining whether spring flow would be reduced by ground water production from the mine. Because data were not available, specific spring flow data were not used in the agencies' numerical model. Some springs and seeps in the mine area have been inventoried, but the inventory did not identify the specific ground water source for each spring or seep, nor did it identify critical springs in the East Fork Rock Creek and East Fork Bull River drainages.

Ground Water Quality

During the mining period, the risk posed by the underground workings of measurable changes to ground water quality would be low because ground water would be moving toward the mine void and adits and then pumped to the surface for use in the ore processing. Any water affected by the mining process, such as an increase in the concentration of nitrogen compounds due to the use of explosives or water contact with oxidizing minerals in the ore body, would be removed from the mine void, used in mill processing, and eventually stored, discharged to LAD Areas, or treated. Mine dewatering and the resulting drawdown of bedrock ground water could result in subtle changes in water quality of various water bodies, such as Rock Lake, and unidentified springs and seeps. Assuming these water bodies receive water from both shallow and deep ground water sources, reducing the source of deeper ground water could reduce the introduction of certain minerals considered to be necessary for potential populations of organisms (Gurrieri 2001, 2004). If this water quality change occurred, it may be difficult to detect or measure.

During the post-mining period after the mine void filled and the surrounding area resaturated (an estimated 70 years), the agencies' numerical model predicts that ground water in the mine void has the potential to flow toward the East Fork Bull River drainage. The predicted concentrations of metals in the mine void ground water would be relatively low. If ground water flowed from the

filled mine void to the East Fork Bull River, attenuation and dilution of the dissolved metals as the ground water moved about 3,000 feet vertically through fractures would likely reduce concentrations. The actual flow path may be longer than 3,000 feet. The fate and transport of dissolved metals within the flooded mine void cannot be predicted without significant uncertainty, particularly considering the relatively low surface water quality standards. MMC intends to construct a three dimensional ground water model during the mine development period when additional hydraulic data would be collected. A calibrated model could be used to evaluate the potential for the migration of dissolved metals from the mine void to surface water drainages such as the East Fork Bull River. If modeling were to indicate potential exceedances of surface water standards in nearby streams, various mitigation measures would have to be adopted prior to active mining. The agencies' numerical model indicates that during the post-mining period, there would be the potential for ground water to flow toward the mine void from the East Fork Rock Creek drainage (including Rock Lake). If this occurred, there may be subtle changes in the water quality of Rock Lake, as described in the previous paragraph.

3.10.4.2.2 Tailings Impoundment

Ground Water Levels and Flow

The Little Cherry Creek Tailings Impoundment is designed with an underdrain system to collect seepage from the tailings and divert intercepted water to a Seepage Collection Pond downgradient of the impoundment. After being discharged into the impoundment, the tailings would consolidate, and water would pool in a reclaim water pond within the tailings impoundment. Water from the reclaim water pond would be pumped back to the mill, but some would percolate downward and be captured by the underdrain system. Some of the percolating water would seep into the underlying fractured bedrock aquifer. Geotechnical investigations near the Seepage Collection Pond indicate that the fractured bedrock is at the surface in the Little Cherry Creek channel beneath the proposed Seepage Collection Dam and farther downstream (Morrison-Knudsen 1990). The Seepage Collection Pond may intercept some of the tailings seepage in the fractured bedrock aquifer. Because bedrock crops out downstream of the proposed dam location, tailings seepage in the fractured bedrock aquifer not intercepted by the Seepage Collection Pond or extracted by a pumpback well system would likely flow into the former Little Cherry Creek channel (USDA Forest Service 2008a). Some of the seepage may flow to Libby Creek via a buried channel beneath the impoundment site. Klohn Crippen (2005) estimated 80 percent of the existing ground water flows toward Little Cherry Creek and 20 percent flows toward Libby Creek via the buried channel. Any tailings seepage is likely to follow existing ground water flow paths if not intercepted.

Tailings seepage not collected by the underdrain is expected to flow to ground water at a rate of about 25 gpm and, after the impoundment is reclaimed, slowly decrease to 5 gpm (Klohn Crippen 2005). The operational seepage estimate was verified by the lead agencies in their independent analysis (USDA Forest Service 2008a). The estimated ground water flux (volume per unit time) beneath the impoundment was estimated to be about 35 gpm (Geomatrix 2007a) using a DEQ standard mixing zone thickness of 15 feet (ARM 17.30.517) and a hydraulic conductivity for the impoundment area of 0.4 ft/day. A conductivity value of 0.4 ft/day is higher than the mean values reported by Klohn Crippen (2005) to estimate tailings seepage for glacial till beneath the Little Cherry Creek Impoundment Site (0.1 ft/day) and for fractured bedrock (0.3 ft/day). The saturated zone beneath the impoundment would be able to accommodate the addition of about 25 gpm from seepage and would respond with a rising water table (slightly increasing the hydraulic gradient) to convey the additional water from beneath the impoundment. Little Cherry Creek appears to be a

gaining stream downgradient of the proposed impoundment based on limited flow measurements and the occurrence of numerous springs.

Springs and Seeps

Numerous springs and seeps were identified in the Little Cherry Creek drainage (Figure 72) (Geomatrix 2006c). Springs SP-15, 23, and 24 would be covered during initial impoundment construction, and a fourth spring (SP-10) would be covered by the Seepage Collection Pond. Seeps in Little Cherry Creek also would be covered during initial impoundment construction. The pumpback well system needed to extract seepage not collected by the underdrain system would likely lower ground water levels and reduce ground water discharge to springs, seeps, and wetlands downgradient the impoundment.

Ground Water Quality

The existing ground water quality would be altered because tailings seepage water quality would have higher concentrations of nutrients, some metals, and total dissolved solids than existing water quality. The agencies completed mass balance calculations (Appendix G) of expected seepage rates and water quality from the tailings impoundment for the construction, mining, and post-mining periods. The uncertainties associated with the mass balance calculations are discussed in section 3.11.2.3, *Impact Analysis* in section 3.11, *Surface Water Hydrology*. Using the DEQ's approach for determining a standard mixing zone (ARM 17.30.517), MMC calculated a ground water flux of 10 gpm. An additional 25 gpm was added to the calculated flux to account for flow in the buried alluvial channel (Geomatrix 2007b). The hydrologic and geologic conditions of the Little Cherry Creek Tailings Impoundment Site are complex. As noted by Morrison-Knudsen Engineers, Inc. (1990), "Complete definition of the hydrogeologic system at the [Little Cherry Creek Tailings Impoundment] site probably would not be possible. Costs associated with substantial definition of the hydrogeologic system would be prohibitive because of the size of the system and its complexity." The agencies used a ground water flux of 35 gpm in the agencies' mass balance calculations as a reasonable estimate of flux beneath the impoundment site. Results of the mass balance analysis are provided in Table 82.

The predicted elevated manganese concentrations would occur in ground water beneath and downgradient of the tailings impoundment. During the MPDES permitting process, the DEQ would determine if a mixing zone beneath and downgradient of the tailings impoundment would be allowed and, if so, would determine the mixing zone's size, configuration, and location. MMC requested a source-specific mixing zone for the tailings impoundment. The DEQ would determine if a source-specific mixing zone should be granted in accordance with ARM 17.30.518. If DEQ granted a mixing zone, water quality changes may occur and certain water quality standards may be exceeded within the mixing zone. The DEQ also would determine where compliance with applicable standards would be measured.

MMC has committed to implementing seepage control measures, such as pumpback wells, if required to comply with applicable standards. Seepage collection wells could be installed along the downstream toe of the tailings dam. Given the heterogeneity of the foundation soils, additional wells could be required to ensure that all of the flow paths were intercepted. The wells may require active pumping, depending on the artesian pressures within the wells (Klohn Crippen 2005).

Table 82. Predicted Concentrations in Ground Water beneath the Tailings Impoundment.

Parameter	Alternatives 2 and 4	Alternative 3	Ground Water Standard or BHES Order Limit
During Construction			
Total dissolved solids	123	123	200
Nitrate	3.9	<3.5	10
Antimony	<0.004	<0.004	0.006
Cadmium	<0.001	<0.001	0.005
Copper	<0.02	<0.02	0.1
Iron	<0.05	<0.05	0.2
Lead	<0.01	<0.01	0.015
Manganese	**<0.15**	**<0.13**	0.05
Silver	<0.002	<0.002	0.1
Zinc	<0.02	<0.02	0.1
During Mining			
Total dissolved solids	141	139	200
Nitrate	6.8	<6.1	10
Antimony	<0.006	<0.005	0.006
Cadmium	<0.001	<0.001	0.005
Copper	<0.02	<0.02	0.1
Iron	<0.05	<0.05	0.2
Lead	<0.01	<0.01	0.015
Manganese	**<0.24**	**<0.22**	0.05
Silver	<0.002	<0.002	0.1
Zinc	<0.02	<0.02	0.1
During Post-Mining			
Total dissolved solids	112	113	200
Nitrate	2.1	<1.8	10
Antimony	<0.004	<0.004	0.006
Cadmium	<0.001	<0.005	0.005
Copper	<0.01	<0.01	0.1
Iron	<0.05	<0.05	0.2
Lead	<0.01	<0.01	0.015
Manganese	**<0.09**	**<0.08**	0.05
Silver	<0.001	<0.001	0.1
Zinc	<0.02	<0.02	0.1

All concentrations are in mg/L.
Predicted exceedances of BHES Order limits or ground water standards are shown in **bold**.

Seepage from the tailings impoundment reaching ground water is estimated to decrease from 25 gpm to 17 gpm 10 years after closure, stabilizing at 5 gpm over the long term (Klohn Crippen 2005). Water quality beneath the impoundment would improve slowly over time as seepage decreased and infiltrated precipitation mixed with water retained in the impoundment. MMC would maintain and operate necessary seepage collection facilities until water quality standards

and MPDES permit limits were met, without treatment, in all receiving waters. MMC also would continue water monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment is required, the agencies would require a bond for the operation and maintenance of the water treatment plant. The level of human activity associated with facility operation, maintenance and monitoring is unknown, but has the potential of being a daily requirement and year-round in duration. The length of time these closure activities would occur is not known, but may be decades or more.

3.10.4.2.3 LAD Areas

Ground Water Levels and Flow

MMC proposes to apply up to 558 gpm of water to the LAD Areas during the mining period (Geomatrix 2007a). There are several considerations for disposal of water on the LAD Areas to avoid runoff from the LAD Areas and minimize the risk of developing springs and seeps downgradient of the LAD Areas. The two basic issues are:

- The maximum application rate that would not result in runoff from the site given site characteristics
- The maximum application rate that could be conveyed away from the LAD Areas by the existing ground water system

The EPA (2006b) and Corps (1982b) published guidelines for the design and operation of LAD Areas that address the first issue. The guidelines provide recommended design percolation rates that consider long-term issues such as wetting and drying cycles, clogging of the soil, etc. Using the guidelines, the maximum application rate that would not result in surface runoff for the LAD Areas is 344 gpm (see section 3.12.2.3, *Impact Analysis* for further discussion).

The existing ground water flux beneath the LAD Areas was estimated to determine the capacity of the underlying shallow aquifer to receive and transport additional water. The agencies initially calculated a ground water flux of 141 gpm, based on the following assumptions:

- Maximum saturated thickness of 56 feet (as reported in well logs), which is greater than the 15 feet using the dispersion assumptions in ARM 17.30.517 for standard mixing zones, but represents actual conditions to the maximum drilled depth
- Mixing zone width beneath the LAD Areas of 6,860 feet, which is increased to 8,060 feet using the dispersion assumptions in ARM 17.30.517 for standard mixing zones, where the mixing zone width is equal to the width plus the distance determined by the tangent of 5 degrees times the length of the LAD Area on both sides
- Existing hydraulic gradient of 0.06 (Geomatrix 2007a)
- A hydraulic conductivity value of 1 ft/day reported by Geomatrix (2007a)

The calculated ground water flux using the reported hydraulic conductivity value requires an unrealistic net infiltration of precipitation rate of about 52 percent of annual precipitation to maintain the ground water flux of 141 gpm through the defined cross sectional area. It is likely that the average hydraulic conductivity value used in the calculation is too high and does not reflect site conditions. The ground water flow direction is generally perpendicular to surface topography contours or downslope and, therefore, ground water recharge is local and discharge is

to the adjacent streams. A small fraction of the total net infiltration may travel along deeper flow paths in the fractured bedrock.

The hydraulic conductivity of 1 ft/day is the only value in the flux calculation that was not directly measured, but rather was selected by MMC (2005) as being more representative of the LAD hydraulic conductivity than the value derived from pit tests. The agencies reduced the hydraulic conductivity value slightly to achieve a ground water flux that is consistent with a reasonable net infiltration rate. The agencies considered 10 percent to be a reasonable net infiltration value to use in the flux calculation for three reasons. In the tailings impoundment design report, Klohn Crippen (2005a) indicated "ground water recharge from infiltration [at the Little Cherry Creek Impoundment Site] was estimated to be 10 percent of yearly precipitation. Infiltration rates could be as low as 5 percent and are not expected to be greater than 12 percent. The relatively low precipitation and forest cover suggest that 10 percent should be the maximum infiltration." MMC also used a 10 percent infiltration rate in the SEEP/W analysis (Klohn Crippen 2005a) to model seepage from the Little Cherry Creek Tailings Impoundment; the agencies' used the same rate in their independent SEEP/W analysis (USDA Forest Service 2008a). The LAD Areas are 2 miles south of the Little Cherry Creek Tailings Impoundment and have similar geology. A 10 percent infiltration rate in areas of less than 30 percent slope also was used in the agencies' numerical ground water model (ERO Resources Corp. 2008b).

An infiltration rate of 10 percent would support a ground water flux of 31 gpm for the LAD Areas. This is similar in magnitude to what was calculated by MMC for the ground water flux through a similar cross sectional area beneath the Little Cherry Creek Tailings Impoundment (35 gpm). Using a ground water flux of 31 gpm (rather than 141 gpm) requires the hydraulic conductivity to be lower (0.22 ft/day) because the other variables in the equation are fixed (gradient and cross sectional area). A conductivity value of 0.22 ft/day is slightly higher than the mean value for glacial till beneath the Little Cherry Creek Impoundment Site (0.1 ft/day) reported by Klohn Crippen (2005).

The agencies calculated the maximum amount of water that could be conveyed away from the site using a hydraulic conductivity value of 0.22 ft/day, and assuming the water table could rise to within about 10 feet of the surface beneath the LAD Areas. The agencies assumed the water table should remain 10 feet below ground surface beneath the LAD Areas so there would be sufficient unsaturated zone to receive the percolating applied water. Because the cross-sectional area and aquifer characteristics would not change during LAD, the hydraulic gradient would steepen to allow more water to move away (downgradient) from the LAD Areas. The increased gradient is estimated to be 0.122. The calculated gradient value of 0.122 is assumed to be the maximum possible gradient with a depth to ground water of 10 feet beneath the LAD Areas. The agencies estimate the ground water flux (preexisting ground water flux plus infiltrated application water) is about 63 gpm, or about 32 gpm of LAD applied water (the difference between maximum possible flux (63 gpm) and the pre-application ground water flux (31 gpm)). Factoring in precipitation and evapotranspiration, the total maximum application rate to the LAD Areas would be about 130 gpm for a LAD Area of 200 acres (Appendix G).

The estimated application rate of 130 gpm that could be conveyed from the LAD Areas is more restrictive than 344 gpm, a rate the agencies calculated using the EPA and USACE guidelines to avoid runoff (EPA 2006b; Corps 1982b). To reduce the likelihood that springs and seeps would develop downgradient of the LAD Areas or that the water table would come to the surface in the LAD Areas, the agencies estimate the maximum application rate would be 130 gpm (for the 200

acres proposed by MMC for land application at LAD Areas 1 and 2). MMC's proposed application rate of 558 gpm would likely result in surface water runoff and increased spring and seep flow on the downhill flanks of the LAD Areas.

The agencies estimated a ground water velocity and travel time between the LAD Areas and the nearest surface water body to aid in planning downgradient ground water monitoring. Using a range of effective porosity values of 1 to 10 percent, ground velocity is calculated to range from about 100 feet per year to 1,000 feet per year. Assuming the nearest stream is about 800 feet downhill from the LAD Areas, the ground water travel time is estimated to be between less than 1 year and 8 years. This calculation does not consider the existence of preferential flow paths that would allow for higher ground water velocities, and a possible shorter travel time.

MMC proposed an alternate set of values for hydraulic conductivity (0.3 ft/day) and cross-sectional width (15,000 feet) in calculating the maximum application rate (Geomatrix 2008b). Because of the limited subsurface data available for the LAD Areas, it is not possible to refine the estimated application rate beyond what is presented in this EIS. Therefore, the analysis presented in this EIS uses more conservative assumptions versus what was suggested by MMC. The maximum application rate would depend on the site conditions, and would have to be determined on a performance basis by monitoring both water quality and quantity changes to the existing ground water system. It is possible that monitoring would determine that the maximum application rate would be higher or lower than estimated by this analysis. The LAD application rates would be selected to ensure that ground water did not discharge to the surface as springs between the LAD Areas and downgradient streams.

Springs and Seeps

The discharge rate of the existing spring (SP-21) between the two LAD Areas (Figure 72) may increase as a result of land application of excess water. Assuming the LAD Areas are operated at the maximum application rate of 130 gpm and the evaporation and precipitation rates assumed in the calculation are representative of site conditions, there should be no increase in the number of springs and/or seeps downgradient of the LAD Areas. Springs or seeps could develop because of unidentified geologic heterogeneities that would result in preferential flow paths to the surface. An increase in the overall water table elevation beneath the LAD Areas as a result of applying a maximum of 130 gpm, based on the assumptions described previously, would have no adverse impacts, with the exception of possible preferential flow paths that could result in increased spring activity.

Ground Water Quality

Percolation from the LAD Areas would enter the ground water system and would discharge at nearby springs and/or eventually to adjacent streams as diffuse flow. The existing ground water quality beneath the LAD Areas would be altered because discharged wastewater percolating into ground water beneath the LAD Areas would have higher concentrations of nitrate, several metals, and total dissolved solids than the existing water quality (Appendix G). Results of the mass balance are provided in Table 83.

Table 83. Predicted Concentrations in Ground Water beneath the LAD Areas.

Parameter	Alternative 2	Alternatives 3 and 4	Ground Water Standard or BHES Order Limit
During Construction			
Total dissolved solids	**376**	**384**	200
Nitrate	**<26.03**	<2.88	10
Antimony	<0.005	<0.005	0.006
Cadmium	<0.0004	<0.0004	0.005
Copper	<0.002	<0.002	0.1
Iron	<0.08	<0.08	0.2
Lead	<0.002	<0.002	0.015
Manganese	<0.04	<0.04	0.05
Silver	<0.001	<0.001	0.1
Zinc	<0.07	<0.07	0.1
During Mining			
Total dissolved solids	**346**	**353**	200
Nitrate	**<17.32**	<2.06	10
Antimony	**<0.009**	**<0.009**	0.006
Cadmium	<0.0003	<0.0003	0.005
Copper	<0.007	<0.007	0.1
Iron	<0.06	<0.06	0.2
Lead	<0.001	<0.001	0.015
Manganese	**<0.08**	**<0.08**	0.05
Silver	<0.002	<0.002	0.1
Zinc	<0.04	<0.04	0.1
During Post-Mining			
Total dissolved solids	**455**	**531**	200
Nitrate	**<16.85**	<2.20	10
Antimony	**<0.011**	**<0.013**	0.006
Cadmium	<0.0021	<0.0025	0.005
Copper	<0.008	<0.009	0.1
Iron	<0.07	<0.07	0.2
Lead	<0.003	<0.003	0.015
Manganese	**<1.02**	**<1.22**	0.05
Silver	<0.004	<0.005	0.1
Zinc	<0.05	<0.05	0.1

All concentrations are mg/L.
Predicted exceedances of BHES Order limits or ground water standards without additional treatment beyond land application in Alternative 2, or beyond nitrate pretreatment and land application in Alternatives 3 and 4 are shown in **bold**.

Concentrations of total dissolved solids, antimony, and manganese in all alternatives, nitrate in Alternative 2, and zinc in Alternatives 3 and 4 are predicted to exceed ground water standards or BHES Order nondegradation limits in one or more phases of mining. The predicted elevated

concentrations would occur in ground water beneath and downgradient of the LAD Areas. During the MPDES permitting process, the DEQ would determine if a mixing zone beneath and downgradient of the LAD Areas would be allowed and, if so, would determine the mixing zone's size, configuration, and location. MMC requested a source-specific mixing zone for the LAD Areas. The DEQ would determine if a source-specific mixing zone should be granted in accordance with ARM 17.30.518. If DEQ granted a mixing zone, water quality changes may occur and certain water quality standards may be exceeded within the mixing zone. The DEQ also would determine where compliance with applicable standards would be measured.

Ground water beneath the LAD Areas would have higher concentrations of total dissolved solids, nutrients, and metals as long as the seepage collection facilities at the tailings impoundment operates and tailings water is discharged at the LAD Areas. Concentrations shown in Table 83 for the post-mining period are those predicted to occur immediately after the mill ceased production. As infiltrated precipitation mixed with water retained by the tailings, the quality of collected tailings seepage would improve, and the concentrations beneath the LAD Areas would be less than those shown in Table 83. The length of time tailings water may be discharged at the LAD Areas is not known, but may be decades or more.

3.10.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.10.4.3.1 Mine Area

Ground Water Levels and Flow

Alternative 3 would have the similar effects and uncertainties on ground water levels overlying the ore body and base flow in Rock Creek and East Fork Bull River as Alternative 2. If hydrologic modeling during initial mine operations (by Year 5 of operations) determined that one ore more bulkheads would be necessary to minimize changes in East Fork Rock Creek and East Fork Bull River streamflows, MMC would submit a plan for bulkheads to the agencies for approval. One or more bulkheads would be maintained underground, if necessary, after the plan's approval. The introduction of a 330-foot (100-meter) thick bulkhead in the agencies' numerical model reduced the post-mining ground water contribution from the mine void to the East Fork Bull River by 50 percent, compared to Alternative 2. The addition of the bulkhead would increase flow slightly to the Rock Creek drainage from the mine void, rather than reducing flow to that drainage without a bulkhead. The agencies' model predicted a bulkhead would increase post-mining ground water pressure in the upper end of the mine void near Rock Lake and would cause ground water to flow toward East Fork Rock Creek, rather than away from it. Ground water pressure in the lower portion of the mine void (below the bulkhead) would be lower than without the bulkhead, reducing ground water flow toward the East Fork Bull River.

In Alternative 3, two adits in addition to the Libby Adit would be in the Libby Creek drainage near the existing Libby Adit. The Ramsey Adits would not be constructed. Changes in base flow in Ramsey Creek would be nearly zero and not measurable in Alternative 3. Three adits in the Libby Creek drainage may reduce base flow in Libby Creek more than predicted for Alternative 2, but the changes would be relatively small, and would depend on the additive effect of two additional adits adjacent to the Libby Adit. The ground water drawdown resulting from inflow to each of the three adits would overlap. The total water production of three adjacent adits would be much less than three adits located beneath different drainages.

Springs and Seeps and Ground Water Quality

Changes in spring and seeps, and ground water quality in the mine area in Alternative 3 would be the same as Alternative 2. Alternative 3 would require implementation of Ground Water Dependent Ecosystem Inventory and Monitoring (Appendix C), focusing on areas below an elevation of about 5,600 feet. Such monitoring would assist in inventorying springs and seeps in the mine area, and in evaluating mine-related changes to springs and seeps.

3.10.4.3.2 Tailings Impoundment

Ground Water Levels and Flow

The Poorman Tailings Impoundment location proposed in Alternative 3 would be located between the Poorman Creek and Little Cherry Creek drainages. The available hydrogeologic data from this proposed impoundment location indicate that the Poorman site is similar to the Little Cherry Creek site with the exception of having generally higher hydraulic conductivity than the Little Cherry Creek site. The effects of Alternative 3 would be similar to Alternative 2 (see section 3.10.4.2.2, *Tailings Impoundment*), with the following differences:

- Based on available data, there does not appear to be a buried channel on the Poorman site, compared to the Little Cherry Creek site, which eliminates the concern of having a high hydraulic conductivity conduit beneath an impoundment that could become a preferential flow path for seepage from the impoundment.
- The impoundment would not be located directly in the Poorman Creek drainage, but north of the drainage. Consequently, the predominant ground water flow direction from beneath the impoundment is to the east toward Libby Creek, rather than toward the much smaller Poorman Creek.
- Any tailings seepage that reached ground water would be more difficult to control than at the Little Cherry Creek site.

In Alternative 3, the agencies identified a possible location for alluvial ground water wells to supply make-up water to the mine, should mine inflow be inadequate for process purposes. To provide any necessary make-up water requirements, a water supply well field located north of the Seepage Collection Pond would draw from Libby Creek alluvial ground water (Figure 26). The proposed well field location has surficial alluvial and glacial deposits up to 200 feet thick and adequate flow in adjacent Libby Creek. Because the tailings would be deposited at a higher density in Alternative 3, less water would be stored initially in the impoundment and more water would be available for mill use. As in Alternative 2, the amount of make-up water required would depend primarily on mine inflows and precipitation at the impoundment site. No make-up would be needed if mine inflows were 800 gpm, and about 150 gpm would be needed if mine inflows were 450 gpm. Ground water levels downgradient of the pumping wells would decrease while the wells were pumped. Appropriately designed, located, and operated make-up wells providing up to 150 gpm would not substantially reduce upgradient alluvial ground water levels.

Springs and Seeps

Five springs were identified in the Poorman Tailings Impoundment Site (Figure 72). Springs SP-26, SP-28, SP-29, and SP-30 would be covered by the impoundment; SP-27 would not be affected. As in Alternative 2, it is possible that the increase in hydraulic head over the springs by placement of saturated tailings would prevent future flow from the springs. Alternately, the springs could discharge to the underdrain system beneath the impoundment and become part of

the seepage collection system. No springs were identified below the Poorman Tailings Impoundment Main Dam and a pumpback well system would not affect any spring flow.

Ground Water Quality

The effect of tailings seepage on existing ground water quality beneath the impoundment is provided in Table 82. Ground water flow beneath the Poorman Impoundment Site is estimated to be slightly higher than at the Little Cherry Creek site. Based on the mass balance calculations, the predicted manganese concentration in ground water would be greater than the BHES Order nondegradation limit of 0.05 mg/L in all three periods. The process of any approval by the DEQ of any mixing zone and compliance with applicable standards in Alternative 3 would be the same as Alternative 2.

Post-operations water quality would be similar to Alternative 2. MMC would maintain and operate necessary seepage collection facilities until water quality standards and MPDES permit limits were met, without treatment, in all receiving waters. The length of time these closure activities would occur is not known, but may be decades or more.

3.10.4.3.3 LAD Areas

Ground Water Levels and Flow

The environmental consequences described for Alternative 2 (section 3.10.4.2.3, *LAD Areas*) would apply to Alternative 3 with the following exception. In Alternative 3, the location and configuration of the LAD Areas are slightly changed, increasing the area from 200 acres to 307 acres. Because of the proposed changes to the total LAD Area, the calculated ground water flux and calculated maximum application rate would be higher. The calculated preapplication ground water flux for Alternative 3 is about 46 gpm and the calculated maximum application rate would be about 198 gpm.

Springs and Seeps

The effects of Alternative 3 on springs and seeps in the LAD Areas would be the same as Alternative 2 (section 3.10.4.2.3, *LAD Areas*).

Ground Water Quality

Ground water quality at the LAD Areas would be similar to Alternative 2 (section 3.10.4.2.3, *LAD Areas*). Treatment of wastewater for nitrates prior to LAD may be required in Alternatives 3 and 4. Such treatment also may reduce the concentrations of total dissolved solids and metals in discharged wastewater. Results of the mass balance analysis are provided in Table 83.

BHES Order nondegradation limits for total dissolved solids and manganese are predicted to be exceeded in ground water without treatment prior to application (the manganese exceedance is in part due to the ambient ground water concentration exceeding the BHES Order nondegradation limit). If excess mine/adit water discharged at the LAD Areas would result in exceedances of applicable ground water standards beyond the boundaries of the mixing zone, MMC has committed to treating the water at the Libby Adit treatment facility and, if needed, an additional water treatment facility. The process of any approval by the DEQ of any mixing zone and compliance with applicable standards in Alternative 3 would be the same as Alternative 2.

Ground water beneath the LAD Areas would have higher concentrations of total dissolved solids, nutrients, and metals as long as the seepage collection facilities at the tailings impoundment operates and tailings water is discharged at the LAD Areas. The length of time these closure activities would occur is not known, but may be decades or more.

An identified spring between the two LAD Areas (SP-21, see Figure 72) would be part of the hydrology monitoring plan (Appendix C). Inclusion of this spring in the monitoring plan would better detect potential changes in water quality beneath LAD Area 1.

3.10.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

3.10.4.4.1 Mine Area

Alternative 4 would have the same effects and uncertainties on ground water levels and springs and seeps overlying the ore body and base flow in Rock Creek and East Fork Bull River as Alternative 3 (section 3.10.4.3.1, *Mine Area*). The effects of the Libby Adits would be the same as Alternative 3. The effect of make-up wells on ground water levels in Alternative 4 would be the same as Alternative 2 (section 3.10.4.2.2, *Tailings Impoundment*). The agencies identified a well field location between Libby Creek and the Little Cherry Creek Impoundment.

3.10.4.4.2 Tailings Impoundment

Changes in ground water flow and quality, as well as in springs and seeps in the Little Cherry Creek Tailings Impoundment Site in Alternative 4 during and after operations, would be the same as Alternative 2. Ground water monitoring would be different from Alternative 2 (Appendix C), and would better detect changes in springs and seeps. The process of approval by the DEQ of any mixing zone in Alternative 4 also would be the same as Alternative 2 (section 3.10.4.2.2, *Tailings Impoundment*).

The amount of seepage collected by the seepage collection facilities may be increased by locating the Seepage Collection Pond with respect to the local geologic conditions. Geotechnical investigations at the Little Cherry Creek Impoundment Site were conducted on behalf of Noranda between 1988 and 1990. Noranda reported that bedrock is exposed in the Little Cherry Creek channel and bedrock extended about 800 feet downstream of the proposed Seepage Collection Dam (Morrison-Knudsen Engineers, Inc. 1990). Ground water modeling conducted by MMC (Klohn Crippen 2005) and independently verified by the agencies (USDA Forest Service 2008a) assumed that the fractured bedrock strata in the Little Cherry Creek drainage is the primary aquifer for ground water flow at the site. The modeling indicated that any tailings seepage not intercepted by the seepage collection and pumpback well systems would likely discharge to the Little Cherry Creek watershed through the fractured bedrock aquifer (USDA Forest Service 2008a). If not intercepted, some of the seepage may flow to Libby Creek via a buried channel beneath the impoundment site. Klohn Crippen (2005) estimated 80 percent of the existing ground water flows toward Little Cherry Creek and 20 percent flows toward Libby Creek via the buried channel. Any tailings seepage is likely to follow existing ground water flow paths. Consequently, siting the Seepage Collection Dam at or below the location where bedrock outcrops in the Little Cherry Creek drainage would increase the likelihood that the seepage would be collected by the dam. In Alternative 4, MMC would conduct additional geotechnical work near the Seepage Collection Dam during final design and site the dam lower in the drainage if technically feasible.

3.10.4.4.3 LAD Areas

Changes in ground water flow and quality during and after operations, as well as in springs and seeps in the LAD Areas, in Alternative 4 would be the same as Alternative 3 (section 3.10.4.3.3, *LAD Areas*. The process of approval by the DEQ of any mixing zone in Alternative 4 also would be the same as Alternative 2 (section 3.10.4.2.2, *Tailings Impoundment*).

3.10.4.4.4 Ground Water Monitoring

A GDE inventory of an area overlying the mine area and subsequent monitoring of GDEs (Appendix C) would be completed in Alternative 4, as described in Alternative 3. A spring between the two LAD Areas (SP-21 see Figure 72) would be part of the hydrology monitoring plan (Appendix C). In addition, flow from springs SP-02, SP-10, S-12, SP-14, SP-15, and SP-29 in the Little Cherry Creek Impoundment Site (Figure 41) would be measured twice in Alternative 4, once in early June when the area was initially accessible, and once between mid-August and mid-September 1 year before construction began. (Springs SP-02 and SP-15 would not be monitored if they were covered by impoundment facilities.) Samples from these springs would be collected 1 year before construction began and analyzed for total dissolved solids, nitrate + nitrite, sulfate, antimony, and manganese. Sampling would be repeated every 2 years until tailings disposal ceased. At each spring, a vegetation survey would be completed 1 year before construction began; the survey and establishment of “trigger plants” would be the same as Alternative 3 (Appendix C). Such monitoring would assist in inventorying springs and seeps in the tailings impoundment area, and in evaluating mine-related changes to springs and seeps.

3.10.4.5 Cumulative Effects

3.10.4.5.1 Past and Current Actions

The Heidelberg Adit is a horizontal tunnel that was constructed in the 1920s. The adit extends about 790 feet into a cliff face located along East Fork Rock Creek about 850 vertical feet below Rock Lake. Ground water flow from the adit is reported to range from 45 to 135 gpm (Gurrieri 2001). In September 2007, flow from the adit was estimated to be 50 gpm and because of dry conditions at the time of the site visit, this flow is considered to be base flow from bedrock. Because flow data were apparently not collected prior to construction of this adit, it is not known if the adit outflow affected base flow in nearby East Fork Rock Creek.

The Libby Adit was constructed between 1990 and 1991 by Noranda and is about 14,000 feet long. Ground water inflow to the adit increased as the adit was driven, peaking at 239 gpm. The steady state flow from the adit was 150 gpm. Surface flow monitoring was insufficient to identify possible reductions in base flow in Libby Creek. It is not known whether changes in base flow, if they occurred, would have been measurable. There were no ground water piezometers at the time the adit was constructed to identify changes in ground water levels near the adit.

3.10.4.5.2 Rock Creek Project

The agencies’ numerical ground water model was used to assess the cumulative effects of the Montanore and Rock Creek mines. The approximate footprint of the Rock Creek Mine was used in the existing agencies’ numerical Montanore model. Using the same conceptual model as used in the agencies’ Montanore numerical model, simultaneous operation of the two mines was modeled to determine the steady-state drawdown in the region and the resulting reduction in ground water contribution to surface water.

The agencies' numerical model predicts that the combined drawdown from the Rock Creek and Montanore mines would merge in the area between the two mines (Figure 74). The agencies' numerical model indicates that only the westernmost portion of the Montanore drawdown cone and the easternmost portion of the Rock Creek drawdown cone would be affected by dewatering at the other mine. The model predicts that there would be more drawdown in the area between the two mines, in response to dewatering activities at both mines, as opposed to drawdown created by a single mine. During the post-mining period, the steady state recovered drawdown cones of the two mines are predicted to merge in the area between the two mines (Figure 75).

Other than ground water drawdown, potential impacts to ground water would be expressed by changes to ground water flow to streams, and springs. Because there is no comprehensive inventory of springs in the area, only ground water contribution to major streams was considered as a measure of the potential impact to ground water. The cumulative analysis predicts the base flow in East Fork Rock Creek and East Fork Bull River would decrease as a result of drawdown from the two mines (ERO Resources Corp. 2008b). No additional impacts would occur in Libby Creek or Ramsey Creek from the Rock Creek Mine. Although the model was calibrated to base flow data, the significance of this analysis is not the absolute values of flow reported for the various drainages, but rather the predicted changes in each drainage relative to the modeled base flow.

The agencies' numerical model predicted mining period changes to base flow in the upper reaches of each drainage of Rock Creek and East Fork Bull River that are relatively large compared to calculated pre-mining base flow (ERO Resources Corp. 2008b). This indicates that the base flow in the upper reaches of each stream could be reduced in the first mile below St. Paul Lake and Rock Lake. The agencies' numerical model indicates that portions of East Fork Rock Creek south of the proposed Rock Creek Mine would experience additional reduction to base flow (ERO Resources Corp. 2008b). The agencies' numerical model also predicts reductions in base flow during the post-mining period, but they are relatively small compared to the predicted base flow and may not be measurable.

3.10.4.5.3 Other Reasonably Foreseeable Actions

No other reasonably foreseeable actions would have cumulative effects on ground water flow or quality.

3.10.4.6 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the Montana Water Quality Act because construction, operation, and closure of the mine and transmission line under all alternatives would be in compliance with all applicable water quality standards and permit requirements.

3.10.4.7 Irreversible and Irretrievable Commitments

A certain percentage of the total precipitation that falls in the Cabinet Mountains flows from the mountains as surface and ground water. The total yield varies from year-to-year as a function of the total precipitation and varying amounts of evapotranspiration. During the mining period, a certain amount of water would be consumptively used by the project, reducing the total yield of the region by that amount. Relative to the total yield, the consumptively used volume is expected to be small. The reduction in yield would be an irretrievable commitment of resources.

After the mine void filled, the total water yield of the region would return to pre-mining conditions, but because of the large mine void, the distribution of water produced along the headwaters of the four major streams that drain the area may be changed permanently. The large mine void with an infinitely high hydraulic conductivity would permanently change the ground water flow paths. The post-mining analysis indicates that changes in ground water contributions to streams are expected to be relatively small compared to the total flow and the changes would probably not be measurable. If the ground water flow system were controlled by structural trends, reduction in base flow may be focused in one or more of the drainages along structural trends. Any change in base flow would be an irreversible commitment of resources.

Because of the permanent change in ground water flow paths, there may be slight changes in the relative contribution of deeper and shallow ground water to surface water bodies such as Rock Lake. The resulting water quality changes would be small and may not be measurable. These changes would be an irreversible commitment of resources.

Springs would be irreversibly covered by the tailings impoundment in all action alternatives.

3.10.4.8 Short-term Uses and Long-term Productivity

As described above, there would be a short-term reduction in available water from this portion of the Cabinet Mountains equal to the consumptive use of the mine. Given the overall flow rate of streams from this area, the total short-term change would be small. There would be no long-term reduction in water availability of this area, but the distribution among the four major drainages may be slightly altered.

3.10.4.9 Unavoidable Adverse Environmental Effects

The consumptive use of ground water by the project would unavoidably reduce the total water yield from this portion of the Cabinet Mountains. The anticipated consumptive use is expected to be small relative to the total water yield of this area. Water yield would remain reduced until the project no longer consumptively uses water, and then slowly return to the pre-mining yield as the mine void filled, which would require about 50 years. An additional estimated 20 years would be required for the drawdown cone above the mine void to recover to near pre-mining conditions. Total yield would be the same after the mine void reached static conditions, when recharge equaled discharge.

Seepage from the tailings impoundment in any action alternative would alter the quality of ground water in a mixing zone primarily by increasing the concentrations of nitrogen and some metals. Similarly, discharges at the LAD Areas would have similar effects on ground water quality, if not treated. Ground water quality effects would decrease following mining operations as seepage decreased. Some seepage from the tailings facility 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 tailings impoundment area would be an irreversible commitment of resources.

3.11 Surface Water Hydrology

This section provides information on existing analysis area streams, springs and lakes, and potential consequences to streamflows, spring flows, and lake levels resulting from the mine and transmission line alternatives. Surface water quality is discussed in section 3.12, *Surface Water Quality*.

3.11.1 Regulatory Framework

3.11.1.1 Applicable State Standards

For all state waters, existing and anticipated uses must be maintained and protected. The following uses are prohibited within floodways and floodplains, unless a variance is obtained:

- A structure or excavation that would cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway
- The construction or permanent storage of objects subject to flotation or movement during flood events (76-5-403, MCA)

For the mine, a variance application must be submitted to the state that provides details on the obstruction or use of a floodway/floodplain and a permit received prior to construction. Approval of a variance is based on the danger to life and property downstream, availability of alternate locations, possible mitigation to reduce the danger, and the permanence of the obstruction or use (76-5-405, MCA). The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts considering the state of available technology and the nature and economics of the various alternatives. A floodplain permit would not be needed for the transmission line if a MFSA certificate is approved.

3.11.2 Analysis Area and Methods

3.11.2.1 Analysis Area

The geographic scope of the analysis area includes all areas where surface water may be affected either by mine operations or by installation and maintenance of the transmission line. This area includes the Ramsey Creek, Poorman Creek, Bear Creek, Libby Creek, Miller Creek, West Fisher Creek, Fisher River, Rock Creek and East Fork Bull River watersheds (Figure 76).

3.11.2.2 Baseline Data Collection

Water resource baseline investigations were initiated in the analysis area by U.S. Borax in 1986 and 1987, continued by Noranda in 1988 through 1994 and by MMC in 2004 and 2005 (Geomatrix 2006d). In addition, the DEQ collected water resources information in the CMW in 1998 to 2000, followed by additional surface water data collection in the CMW by MMC in 2005. Streamflow measurements were collected in the analysis area by the KNF between 1960 and 2006. Additional streamflow measurements also were collected by Noranda and MMC from 1998 through 1995 and 2001 through 2005 and by the DEQ in 1998 to 2000. Streamflow monitoring stations are shown on Figure 76. Gaged streamflow sites are on Libby Creek at U.S. 2, West

Fisher Creek, Miller Creek, lower East Fork Bull River, and lower Rock Creek. Four gaged sites also are on the Fisher River. The Northern Region of the Forest Service is conducting a long-term air quality study, which began in 1992, that includes lake chemistry monitoring of Upper and Lower Libby Lakes. Surface water investigations included a review of previous permits and authorizations, existing water use, an analysis of the watersheds potentially impacted by the project, floodplain mapping, streamflow, spring flow, peak streamflow calculations, and surface water quality sampling.

3.11.2.3 Impact Analysis

To determine changes in streamflows, spring flows, and lake levels that may occur during mine construction, operations, and post-mining, MMC's plans for capturing, using, and discharging water within each affected watershed were evaluated. This includes alterations in streamflows and the capture of precipitation and runoff. In addition, because the mine would intercept ground water that may be a source of water to springs, lakes, and streams, the effects to surface water from underground mining also were evaluated.

To determine if mine or transmission line facilities would be located within designated 100-year floodplains, a GIS analysis was completed by overlaying the proposed facilities over the FEMA Q3 flood data for Sanders and Lincoln counties. GIS analysis for the transmission line alternatives included comparing the stream and floodplain crossings required for the mine and transmission line alternatives, providing the watershed acreage for Class 1 and 2 streams where roads would be built or trees cleared for other purposes, and determining the acreages of disturbance for 303(d)-listed streams.

A two-dimensional numerical model of the Montanore mine area was developed to assess mine inflow and changes to base flow (ERO Resources Corp. 2008b). The primary objective of using this model was to establish a hydrogeologic framework that could be used to evaluate potential mine impacts and develop possible impact mitigation. The base flow of the mine area streams was modeled, as was the interaction of stream base flow with the ground water system.

To assess the effects of streamflow changes resulting from a tailings impoundment for each alternative, the agencies analyzed the changes in watershed areas as an indicator of possible streamflow changes (ERO Resources Corp. 2008a in Appendix H). It was assumed that watershed area is directly related to streamflow in the receiving stream of each watershed and that differences in runoff due to elevation, soil type, vegetative cover, slope, and aspect are negligible across the analysis area. Within the small watersheds of the tailings impoundment sites, these differences are likely small. The existing footprints for the tailings impoundments and associated facilities were plotted over the watershed boundaries. Changes to all watersheds were either added or subtracted from the existing watershed area, depending on whether the change would increase or decrease watershed area, and therefore water, to the watershed. Calculations were completed for the three alternatives for operations and post-closure periods. The watershed analysis is presented in Appendix H.

Because of the limited baseline streamflow data available for the analysis area, 7-day, 10-year ($7Q_{10}$) flow, and average annual streamflow were derived for specific stream locations. The $7Q_{10}$ flows were calculated using a USGS method developed for ungaged watersheds (Hortness 2006). The USGS method requires the drainage area and mean annual precipitation to estimate the $7Q_{10}$ flow. The drainage area was calculated from KNF watershed mapping, with small adjustments made for specific locations based on USGS topographic maps. Mean annual precipitation was

estimated using a weighted area average precipitation within the drainage area. Precipitation data were obtained from the Poorman Creek SNOTEL site and PRISM model (Geomatrix 2006d). The $7Q_{10}$ values are presented in section 3.12.2.3.2, *Water Quantity*.

Two USGS gaging stations were operated for many years on Granite Creek (elevation 2,780 feet above mean sea level) and Flower Creek (elevation 2,866 feet above mean sea level), located south of Libby (U.S. Geological Survey 2007). To estimate average monthly flows, the gage data from Granite and Flower creeks were used to derive monthly flow per unit area values, which were then applied to specific locations in the analysis area. Although the Granite and Flower creek watersheds are somewhat different from watersheds in the analysis area, they are the only long-term continuously gaged watersheds near the analysis area and provide the best available information for this evaluation.

The KFP contains water yield guidelines based on instream resource values (Appendix 18, KFP, USDA Forest Service 1987). Forest clearing for roads or other activities often alters normal streamflow dynamics, particularly the volume of peak flows and base flows. The degree to which streamflows change depends on the road density, percentage of total tree cover removed from the watershed, and the amount of soil disturbance caused by the harvest, among other things. For example, if harvest activities remove a high percentage of tree cover and cause light soil disturbance and compaction, rain falling on the soil would infiltrate normally. Due to the loss of tree cover, evapotranspiration (the loss of water by plants to the atmosphere) would be much lower than before. Thus, the combination of normal water infiltration into the soil and decreased uptake of water by tree cover results in higher streamflows. In general, timber clearing on a watershed scale results in water moving more quickly through the watershed (*i.e.*, higher runoff rates and higher peak and base flows) because of decreased soil infiltration and evapotranspiration. Water yield estimates for the analysis area were determined using the KNF beta version of the Equivalent Clearcut Acres Calculator (ECAC) (KNF 2007b). The ECAC Model was designed as a quick-analysis tool to estimate the potential effects of activities such as road, transmission line, and mining disturbances. The ECAC model results are provided in Appendix H.

For lakes and springs, potential changes in lake levels or spring flows were qualitatively evaluated based on changes to the ground water table. Springs located within or downgradient of the footprints of the LAD Areas also were evaluated for changes in flows based on estimated percolation rates to ground water from the LAD Areas. Effects on springs have been discussed in section 3.10.4.2.1, *Mine Area*.

3.11.3 Affected Environment

3.11.3.1 Lakes

Several alpine lakes occur in the analysis area (Figure 76). Many of these lakes are located in glacial cirques that act as collection basins for runoff and snowmelt. Libby Lakes and Isabella Lake are small and lie within closed depressions along the crest of the Cabinet Mountains. Upper Libby Lake is a tributary to the East Fork Rock Creek watershed and Middle and Lower Libby Lakes are tributary to the Libby Creek watershed. Ramsey Lake, a small lake, is in the upper Ramsey Creek watershed. Howard Lake, located near the upper end of Howard Creek, a tributary to Libby Creek, is 33 acres in size and is adjacent to a KNF campground. Howard Lake is located

near the transmission line analysis area. Rock Lake and St. Paul Lake are described, respectively, in the Rock Creek and East Fork Bull River watershed descriptions.

3.11.3.2 Springs

Numerous springs occur in the analysis area and have been discussed in section 3.10, *Ground Water Hydrology*.

3.11.3.3 Streams and Floodplains

Underground mining would occur beneath a divide separating three drainages: East Fork Rock Creek, East Fork Bull River, and Libby Creek. Proposed surface mine facilities in all mine alternatives would be located primarily in the Libby Creek drainage. The area is drained on the east by Libby Creek and its tributaries: Ramsey Creek, Poorman Creek, and Little Cherry Creek (Figure 76). Libby Creek flows north from the analysis area to its confluence with the Kootenai River near Libby. The East Fork Rock Creek flows southwest into the Clark Fork River downstream of Noxon Reservoir. The East Fork Bull River flows northwest into the Bull River.

The transmission line corridor area is drained by the Fisher River and its tributaries: Hunter Creek, Sedlak Creek, Miller and North Fork Miller creeks, Standard Creek, and West Fisher Creek; and by Libby Creek and its tributaries: Howard Creek, Midas Creek, and Ramsey Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the analysis area (Figure 76). One-hundred-year floodplains have been designated along the Fisher River, Miller Creek, an unnamed tributary to Miller Creek, Ramsey Creek, and Libby Creek (Power Engineers, Inc. 2006a).

Snowmelt, rainfall, and ground water discharge are the main sources of supply to streams, lakes, and ponds in the analysis area. Precipitation ranges from 100 inches per year at higher elevations in the Cabinet Mountains to about 30 inches per year at the tailings impoundment site (Geomatrix 2006a). The highest precipitation occurs in November through February and the lowest in July through October.

Base flow is the flow of a perennially flowing stream without any direct surface water runoff; such flow is the result of ground water seepage into the stream channel. During the driest portions of the year when there is no surface runoff either from snowmelt or rain, the only flow in a perennial stream is base flow. Because the near surface geology varies between the upper and lower reaches of streams in the project area, the source of ground water to streams also varies. In the upper reaches, there is little if any alluvium or colluvium and very little, if any, weathered bedrock. Therefore, the primary source of ground water to in the upper stream reaches is fractured bedrock. The thickness of the unconsolidated surficial deposits and weathered bedrock that may contribute ground water to streams increases in a downstream direction. Because the fractured bedrock is hydraulically connected to the weathered bedrock and surficial deposits, it is difficult to separate the individual sources of ground water flow to streams in the middle and lower reaches of the drainages. It is likely that base flow in the lower reaches is dominated by ground water flow from the thicker surficial deposits. During the year, there is probably an ever-changing ratio between shallow ground water (from the surficial deposits and weathered bedrock) and deeper bedrock ground water contributions to any one stream. Project area streams do not reach base flow every year.

3.11.3.3.1 Watershed Descriptions

Libby Creek

Libby Creek is the primary watershed within the analysis area. Libby Creek flows northward and joins the Kootenai River near the town of Libby. Its entire 29-mile length is rated as outstanding (Class 1) for fisheries habitat by the FWP (FWP 2008a). Within the analysis area, the primary tributaries to Libby Creek are Ramsey, Poorman, Little Cherry, and Bear creeks (Figure 76). Libby Creek originates in a steep, glacial-carved basin at an elevation of 5,600 feet, and discharges to the Kootenai River 29 miles downstream at an elevation of about 2,000 feet. Libby Creek drains an area of about 68 square miles upstream of where the stream crosses U.S. 2. The uppermost reach of Libby Creek is intermittent and restricted to a narrow canyon channel flowing across bedrock or coarse valley-fill and glacial deposits. The Libby Creek valley widens downstream, where more erodible alluvial, glaciolacustrine, and glaciofluvial deposits are encountered. In these lower reaches, Libby Creek is perennial, with flow sustained by ground water discharge. Libby Creek is the only stream in the mine area that has a well-developed floodplain. Libby Creek is a large, third-order stream near the proposed mine facilities. It is primarily restricted to a narrow channel flowing through bedrock canyons, erodible valley fill material, and glaciolacustrine sediment. Unstable stream channel characteristics in the Libby Creek drainage can be attributed, in part, to historic placer mining by hand (late 1800s), hydraulic and dredge mining (early to mid-1900s), and logging/clearcutting (early to mid-1900s).

Ramsey Creek

Ramsey Creek originates at an elevation of 4,400 feet and discharges to Libby Creek 5.3 miles downstream, at an elevation of 3,425 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. The total drainage area for Ramsey Creek is about 6.5 square miles. The upper watershed is poorly drained and contains both a marshy area and Ramsey Lake, a small lake of about 2 acres (Figure 76). Water in the marsh flows through a series of ponds and meanders through grassy, wet meadows. Downstream of the meadows, Ramsey Creek is a high-energy stream flowing through a series of narrow bedrock canyons and glacial moraine material. Ramsey Creek is a perennial stream with heavily forested banks. Near the proposed mine facilities, Ramsey Creek is a second order stream.

Poorman Creek

Poorman Creek originates at an elevation of 5,400 feet and joins Libby Creek 5.3 miles downstream, at an elevation of 3,315 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. The drainage area is about 6 square miles. Poorman Creek is a small, perennial stream located south of the Poorman Tailings Impoundment Site and north of the LAD Areas. Near the proposed mine facilities, Poorman Creek is a second order stream. The creek flows in a narrow, straight channel with several small intermittent tributaries, heavily forested banks, and a boulder, cobble, and gravel bed. Streamflow is relatively constant both upstream and downstream.

Little Cherry Creek

Little Cherry Creek is a perennial stream originating on the lower slopes of the Cabinet Mountains at an elevation of about 4,100 feet. It drains about 1.9 square miles, and flows 3.1 miles to its confluence with Libby Creek. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. Streambed material ranges from boulders to sand and silt. Little Cherry Creek is incised into glaciolacustrine and glaciofluvial sediment, with a steep gradient

reach where bedrock outcrops in the lower section near its confluence with Libby Creek. Little Cherry Creek gains water from ground water discharges throughout its length (USDA Forest Service 2008a). Near the Little Cherry Creek tailings impoundment, Little Cherry Creek is a second order stream.

The upper portion of the watershed is forested and the lower portion has been logged. In logged areas, stream banks are collapsed, and small shrubs and forbs have become established. The average bankfull width of upper Little Cherry Creek is 8 feet and in the lower creek is 14 feet. Bankfull width is the width of the stream when carrying the 1.5- to 2-year peak flow (Rosgen 1996).

Bear Creek

Bear Creek is the largest tributary of Libby Creek in the analysis area, draining a 15-square mile area. Originating in a glacial basin at an elevation of about 7,100 feet, Bear Creek flows perennially 8.2 miles, converging with Libby Creek at an elevation of 3,050 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. Bear Creek is incised into lake bed (glaciolacustrine) silt, although small areas of exposed bedrock occur in portions of the channel area. Most of the watershed is heavily forested. The streambed material is composed primarily of cobbles and gravels.

Rock Creek and Rock Lake

Rock Creek is formed by the convergence of the east and west forks of the creek, which drain an area of about 33 square miles of steep, high-elevation terrain. Underground mining would occur under the headwaters of the East Fork Rock Creek. The 5.6 miles of the East Fork Rock Creek is rated as limited (Class 6) for fisheries habitat by the FWP. Below the confluence of the east and west forks of the creek, Rock Creek is rated as moderate (Class 4) for fisheries habitat.

The headwaters of the East Fork Rock Creek are above Rock Lake. During periods when there is no snow in the East Fork Rock Creek basin and there has been no recent precipitation, the only source of water to the upper creek and Rock Lake is deep bedrock ground water (see section 3.10.3.1, *Bedrock Hydrogeology*). Below Rock Lake at Rock Creek Meadows shallow ground water also becomes a source of supply to the East Fork Rock Creek.

Rock Lake, at an elevation of 4,958 feet, has a 1.1 square mile watershed, a 58-acre surface area, a mean depth of 30 feet, and a maximum depth of 70 feet. Rock Lake is fed by a short perennial stream and the source is snowmelt during the spring and early summer, as well as ground water throughout the year (Gurrieri 2001). Rock Lake is located along the Rock Lake Fault. The residence time of the lake water is very short during the spring snowmelt period (a few days), and lengthens significantly later in the year. The lake is a flow-through system—the lake gains surface and ground water from the area above it and loses water via evaporation, a surface outlet and, presumably, to ground water to the area below it, most likely via bedrock fractures. Stage changes in Rock Lake were measured from mid-July through mid-October in 1999; the total decrease in lake level during that time was 11 inches (Gurrieri 2001).

East Fork Bull River and St. Paul Lake

The East Fork Bull River has several tributaries that drain an area of about 26 square miles of the CMW. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. During periods when there is no snow in the East Fork Bull River basin and there has been no recent precipitation, the only source of water to the uppermost part of the drainage (above St. Paul Lake)

may be deep bedrock ground water. Spring SP-32, located above St. Paul Lake, has not been confirmed to flow during a late summer base flow period, so it is uncertain whether this spring contributes water to St. Paul Lake during the late summer season.

St. Paul Lake, elevation 4,715 feet, has a 9-acre surface area, and is located along the Rock Lake Fault near the top of the watershed. An area of about 1.5 square miles drains into St. Paul Lake. The lake is dammed by glacial moraine material, and outflow from the lake is through the glacial gravels to a small pond located a few hundred feet downstream and eventually to the East Fork Bull River drainage. Seasonal stage changes have not been measured in St. Paul Lake, but the lake level has been observed to fluctuate to a much greater extent than does Rock Lake due to leakage through the relatively high permeability morainal material (Gurrieri, pers. comm. 2008). St. Paul Lake has been observed to completely dry during extended periods of little to no precipitation.

Howard Creek and Howard Lake

Howard Creek is a tributary to Libby Creek. Howard Lake is located near the headwaters of Howard Creek at an elevation of 4,100 feet and is 33 acres in size. All of the transmission line alternatives would cross lower Howard Creek and two of the transmission line alternatives would cross upper Howard Creek at its headwaters. The drainage area is about 2.3 square miles, and the watershed begins at about 5,380 feet. The creek is about 2.8 miles long. The entire length of Howard Creek is rated as outstanding (Class 1) for fisheries habitat by the FWP.

Midas Creek

Midas Creek is a tributary to Libby Creek that flows from the southeast into Libby Creek a short distance downstream of Poorman Creek. The North Miller and Modified North Miller transmission line alternatives would cross upper Midas Creek. The drainage area is about 6 square miles, and the watershed begins at about 5,750 feet. The creek is about 3.3 miles long. The entire length of Midas Creek is rated as outstanding (Class 1) for fisheries habitat by the FWP.

Miller Creek

Miller Creek is a tributary to the Fisher River located southeast of the mine area. Three transmission line alignment alternatives follow Miller Creek for about 2 miles immediately west of U.S. 2. The drainage area is about 12 square miles; the watershed is relatively low, starting at about 5,600 feet in elevation. Its entire 6.2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP. The transmission line alignment in Alternatives B and C would parallel an unnamed tributary to Miller Creek that flows from the north into Miller Creek. The drainage area of this tributary is 1.9 square miles, the top of the watershed begins at about 5,400 feet, and the length of the tributary is about 2.4 miles.

West Fisher Creek

West Fisher Creek is also located southeast of the mine area. The West Fisher Creek transmission line alignment generally parallels the creek for about 5 miles. It has a large drainage area (44 square miles) that originates at about 7,500 feet in the CMW. The creek has several lakes in its headwaters and numerous tributaries. Its entire 13.3-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP.

Fisher River

The Fisher River is a tributary to the Kootenai River. The river is formed by two tributaries, Silver Butte Fisher River and Pleasant Valley Fisher River. Miller Creek and West Fisher Creek

flow into the river 3 to 4 miles below the confluence of the two tributaries. The river is 63 miles long and has a watershed area of 838 square miles. In the analysis area, the river is rated as substantial (Class 3) for fisheries habitat.

Hunter Creek

Hunter Creek has a small drainage area (1.64 square miles) that originates east of U.S. 2. All transmission line alternatives except the West Fisher Creek alignment cross the creek. Most of the watershed is on Plum Creek lands. Hunter Creek's 2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP.

Sedlak Creek

The Sedlak Creek watershed is immediately south of Hunter Creek. Sedlak Creek flows into the Pleasant Valley Fisher River about 1,000 feet east of the proposed Sedlak Park Substation Site. Preliminary design indicates all transmission line alternatives except Alternative B would span across a bend in the creek; it may be possible to avoid spanning the creek during final design. Sedlak Creek has a small drainage area (1.04 square miles) that originates at an elevation of 4,200 feet. Most of the watershed is on Plum Creek lands. Sedlak Creek's 2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP.

Standard Creek

Standard Creek, a tributary to West Fisher Creek and the Fisher River, drains a portion of the transmission line corridor area, but would not be affected by the mine or by construction and maintenance of the transmission line. Short segments of the Miller and West Fisher Creek transmission line alternatives would be within the Standard Creek watershed, but the line and any associated access roads would be located more than 1 mile from the creek. The agencies expect that Standard Creek would not be affected, and it is not discussed further.

3.11.3.3.2 Streamflow

None of the streams within the analysis area have been continuously gaged on a long-term basis, but flows have been occasionally measured, mostly at lower elevations and nearly all outside of the CMW. In all of the streams measured (Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Miller Creek, West Fisher Creek, Rock Creek, and the East Fork Bull River), the highest flows occur annually between April and June, with the highest flows most often occurring in May, then secondly in April. There are typically smaller, short-term increases in streamflows in October through March due to precipitation and snowmelt events. Base flows occur most often from mid-August to mid-September, but may occur for up to 2 months during late summer to early fall and also may occur during November through March. Streamflow in the analysis area were often not measured during November through February. Highest and lowest measured flows are provided for each stream in Table 84.

The area is sometimes subjected to strong warm-frontal storms during the winter months that bring heavy rain, warm temperatures, and strong winds. Depending on storm intensity and soil and snowpack moisture conditions, these storms can produce very high streamflows. For example, in December 2004, the KNF measured a flow of 560 cfs at the West Fisher Creek site. This flow, equivalent to the highest flow measured at this site in June 2006, was due to a rain-on-snow event. Rain-on-snow events occur about every 6 years (Wegner, pers. comm. 2006c). In addition to causing high streamflows, the high rate of water input to the soil can generate unstable

conditions on hill slopes. During such high flows, landslides can occur and stream channels may be altered by bank erosion, down cutting, and redistribution of sediment and large woody debris.

Table 84. Measured High and Low Flows in Analysis Area Streams.

Stream	Station	Sampling Period	Minimum Streamflow (cfs)	Maximum Streamflow (cfs)	Number of Measurements
Libby Creek	LB-100	4/88 to 10/88	1.1	50.7	9
	LB-200	4/88 to 10/94	1.2	113	35
	LB-300	9/89 to 6/05	1.6	148	32
	LB-500	4/88 to 9/89	1.0	173	22
	LB-800	4/88 to 6/03	2.9	250	34
	LB-1000	2/91 to 10/94	2.9	77.5[1]	15
	LB-2000	4/88 to 10/93	5.8	204	27
	LB-3000	4/88 to 10/93	10.6	319	Numerous[2]
	U.S. 2	3/99 to 8/08	4.0	1,076	44
Ramsey Creek	RA-100	4/88 to 10/93	0	60.9	18
	RA-200	4/88 to 10/93	0.5	62.8	24
	RA-600	4/88 to 5/05	1.2	119.5	35
Poorman Creek	PM-500	4/88 to 10/93	0.5	85.4	24
	PM-1000	4/88 to 6/05	0.7	62	30
Little Cherry Creek	LC-100	4/63 to 9/65 and 4/88 to 6/05	0.1	15	60
	LC-USFS	4/63 to 9/65	0.2	15	30
	LC-600	4/88 to 6/05	0.2	13.2	12
	LC-800	4/91 to 6/05	0.2	9.7	12
Bear Creek	BC-100	4/88 to 10/88	1.8	98.1	9
	BC-USFS	11/60 to 9/65	5.0	230	31
	BC-500	4/91 to 6/05	2.8	101	13
East Fork Rock Creek	EF-200	10/78 to 9/05	0.8	15.3	8
	EF-300	9/88 to 10/88	0.4	6.5	2
	Upper Rock Ck	12/74 to 8/84	1.7	252	21
East Fork Bull River	Lower EF Bull River	12/74 to 6/00	4.6	522	83
Miller Creek	Miller Ck	5/78 to 4/82	10.6	63.5	3
West Fisher Creek	West Fisher Ck	10/01 to 8/08	8.6	669	34

[1] LB-1000 not measured during peak spring runoff.
[2] LB-3000 flow measured with a continuous recorder in 1988 and 1989.
Station locations are shown on Figure 76.
cfs = cubic feet per second.
Source: Geomatrix 2006d; Neesvig, pers. comm. 2006; Wegner, pers. comm. 2006d.

Over the past 20 years, rain-on-snow events occurred in the KNF in 1990, during the fall and winter of 1995-96 and in 2005. These events caused extensive damage to road drainage and stream crossing structures throughout the KNF. Channel alterations caused by ice flows associated with these events occurred to most stream systems in the Libby Ranger District and resulted in streambed scouring. The rain-on-snow event that occurred in February 1996 resulted in down cutting of most perennial channels by about 2 to 3 inches.

For some of the higher-elevation gages within the analysis area, the lowest flows measured (August and September for Libby and Ramsey creeks, September and October for East Fork Rock Creek) are provided in Table 85. It is unknown whether the flows provided in this table represent base flows for these locations.

Table 85. Low Flows Measured at Three Stream Locations in Analysis Area.

Stream	Station	Number of Measurements	Range of Flows (cfs)	Average Low Flow (cfs)	Median Low Flow (cfs)
Libby Creek	LB-300	6	1.6 to 8	3.9	3.8
Ramsey Creek	RA-200	4	0.5 to 1.7	1.2	1.2
East Fork Rock Creek	EF-200	3	0.8 to 2.2	1.6	1.8

Station locations shown on Figure 76.
cfs = cubic feet per second.
Source: Geomatrix 2006d; Neesvig, pers. comm. 2006.

MMC completed synoptic flow measurements in late August 2005 at selected locations along Ramsey Creek, Poorman Creek, Little Cherry Creek, and Libby Creek (Table 86). These data indicate that the three tributaries to Libby Creek are gaining streams, with inflow from ground water (although some of the Little Cherry Creek measurements do not suggest this). Some of the flow in Libby Creek between stations LB-500 and LB-800 apparently infiltrates to the subsurface, because the increase in flow from 1.6 to 2.8 cfs does not account for the 2.8 cfs coming in from Ramsey Creek (RA-600) and unknown flow from Howard Creek. Libby Creek below LB-800 apparently gains some flow from ground water.

3.11.3.4 Little Cherry Creek Tailings Impoundment Site Stream Channel Characteristics

At the Little Cherry Creek Tailings Impoundment Site, the Little Cherry Creek channel substrate material is predominantly gravel. Channel bankfull width is about 9 feet and the maximum bankfull depth is 0.7 to 1.2 feet. The flood-prone width ranges from 13 to 17 feet. The channel gradient near LC-1 (Figure 76) is 4 percent. The channel is stable, and the stream contains pools and riffles. Bedrock outcrops in the channel downstream of the Seepage Collection Dam Site.

Using the best available information (unit area average flows for Granite and Flower creeks, USGS gaged streams located near Libby), mean monthly and annual flows were calculated for Little Cherry Creek at the upgradient end (LC-100, elevation 3,720 feet above mean sea level) and downgradient end (LC-600, elevation 3,380 feet above mean sea level) of the proposed Little Cherry Creek Tailings Impoundment (Table 87).

Table 86. Synoptic Streamflow Measurements.

Ramsey Creek	Poorman Creek	Little Cherry Creek	Libby Creek
RA-1 = 1.79	PM-500 = 1.07	LC-100 = 0.16	LB-500 = 1.55
RA-2 = 1.93	PM-1 = 0.76	LC-1 = 0.17	LB-800 = 2.82
RA-3 = 2.26	PM-2 = 1.03		LB-2000 = 8.86
RA-4 = 2.34	PM-3 = 1.5	LC-100 = 0.11*	
RA-600 = 2.79	PM-4 = 0.91	LC-1 = 0.33*	
	PM-1000 = 0.77	LC-800 = 1.82*	
	PM-5 = 1.93		
		LC-1 = 0.37**	
		LC-800 = 0.31**	

All flows are in cubic feet per second.
Station locations are shown on Figure 76.
Measurements made August 24–26, 2005, except data with (*) measured June 25–26, 2005 or data with (**) measured July 30–31, 2005.
Source: Geomatrix 2006d.

Table 87. Calculated Mean Monthly, Annual, and Unit Area Flows for Little Cherry Creek.

Little Cherry Creek at Downgradient End of Little Cherry Creek Tailings Impoundment near Station LC-600 (drainage area = 2.2 mi^2)												
Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual or Monthly Average**
1.85	2.07	2.49	8.54	19.2	19.1	6.25	2.05	1.69	2.18	2.79	2.84	5.96
Little Cherry Creek at Upgradient End of Proposed Tailings Impoundment near Station LC-100 (drainage area = 0.9 mi^2)												
0.76	0.85	1.02	3.49	7.86	7.82	2.56	0.84	0.69	0.89	1.14	1.16	2.44

Station locations shown on Figure 76. Units are cubic feet per second based on drainage areas calculated by Geomatrix (2006a).

3.11.3.5 Poorman Tailings Impoundment Site Stream Channel Characteristics

Four channels in the alternate Poorman Tailings Impoundment Site flow east toward Libby Creek (Figure 26). Channel A begins east of Little Cherry Creek and flows toward Libby Creek. Channel B and two other channels join just west of Libby Creek and then flow toward Libby Creek. Little Cherry Creek would be diverted into the northern two channels (Channels A and B) in Alternatives 2 and 4. The four channels are stable and have only intermittent flows that have not been measured. Between the lower Libby Creek floodplain and NFS road #1401, for a reach of about 1,000 feet, Channel A has a low gradient (3.5 percent), except for a short segment where it drops abruptly into the Libby Creek floodplain. No channel is present and surface flow is dispersed in an unconfined reach of grass and alder. The next reach of about 2,000 feet is steep (9 to 15 percent) with a moderately defined channel. The uppermost 3,200 feet consists of a well-defined, low to moderate gradient (3 to 6 percent) channel with gravel and small cobbles. The bankfull width is about 2 feet (Geomatrix 2006b). Channel B is mostly a vegetated depressional

drainage with only very small portions that are scoured channel. Channel B has a shallow gradient and does not connect directly to Libby Creek. Flow in the Channel B is infrequent and most of the water infiltrates into the ground. The two southernmost channels start at a wide, flat topographical bench and drain off the snow pack. Of the four channels, flow in the southernmost channel is perennial; the other three channels have perennial segments, and are intermittent in the lower segments near Libby Creek (Corps 2008).

3.11.4 Environmental Consequences

3.11.4.1 Alternative 1 – No Mine

Under this alternative, MMC would not develop the Montanore Mine. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Without the mine, stream and spring flows, as well as lake levels, would be unchanged from existing conditions.

3.11.4.2 Alternative 2 – MMC Proposed Mine

In MMC's proposal, the mill and production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile from the CMW boundary (Figure 3). An additional adit on MMC's private land in the Libby Creek drainage and a ventilation adit on MMC's private land east of Rock Lake would be used for ventilation. A tailings impoundment would be constructed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek are proposed to allow for wastewater discharge using sprinklers during the growing season. A portion of the waste rock produced by driving the adits may be stored temporarily at LAD Area 1, and at the Libby Adit Site, before use in construction.

3.11.4.2.1 Effects of Inflows During Construction and Mining

Conceptual Model of Surface and Ground Water Connection

MMC's and the agencies' conceptual models of the Montanore mine area hydrogeology are described in section 3.10.3.1, *Bedrock Hydrogeology*. The agencies' conceptual model, which is considered more conservative and was used for the EIS analysis, is that springs and streams that exist above an elevation of about 5,600 feet are not hydraulically connected to deeper bedrock ground water and are supported by surface runoff and/or infiltration of precipitation into thin, unconsolidated, discontinuous surface deposits. Springs and streams located below this elevation are supplied by surface runoff, shallow ground water, and ground water in deeper bedrock fractures that intersect the ground surface.

Numerical Model of Surface and Ground Water Connection

The agencies' numerical model of the Montanore mine area predicted that ground water drawdown would occur as a result of mine dewatering. The model also predicted that about 450 gpm of water would be produced on a steady state basis from the mine and adits at full buildout. Because ground water is one of the sources of supply to mine area streams, the model predicted that ground water contribution to mine area streams would be reduced by an amount equivalent to the water produced as a result of mine dewatering. The agencies' numerical model predicts that

affected streams would be Ramsey Creek, Libby Creek, East Fork Rock Creek, and the East Fork Bull River. Estimated changes to the base flows of these streams are provided in the *Hydrogeology Technical Report* (ERO 2008b) and discussed in section 3.10.4.2.1, *Mine Area*. About 60 percent of the model-predicted flow reductions that would occur during mining would be in the East Fork Bull River and Rock Creek drainages west of the divide and 40 percent would be in the Libby Creek watershed east of the divide. If the ground water flow system were controlled by structural trends, reduction in base flow may be focused in one or more of the drainages along structural trends, rather than being distributed as predicted by the model.

Changes in Base Flow

Changes to the base flow of area streams as a result of mining may occur where stream channels intercept bedrock fractures that provide base flows to the streams. The change in base flow at the highest elevations on Ramsey Creek, Libby Creek, East Fork Rock Creek, and the East Fork Bull River may be manifested as a change in elevation at which the streams become perennial. Changes in base flow would most likely be detected during the driest portions of the year when there is no surface runoff, which is typically mid-August to mid-September, but could occur for longer periods in late summer to early fall and in the winter. Changes at some locations may not be measurable or even detectable for several reasons. First, it is difficult to measure streamflow in the mine area using a streamflow meter to an accuracy greater than plus or minus 10 percent (Wegner, pers. comm. 2007). Second, the base flow of a stream may change over time due to climatic variability. The elevation at which the streams become perennial may change from year-to-year based on seasonal precipitation. Third, available base flow data within the analysis area are lacking, particularly in higher elevation stream segments. Given the natural variability of base flows, it would likely be necessary to collect stream base flow data for a number of years to be able to compare to flow data collected during mining.

Libby Creek. The agencies' numerical model predicts a decrease during mining in the base flow of Libby Creek within and downstream of the CMW. The flow changes would be difficult to measure, particularly in the lower reaches where base flow increases substantially. In addition, changes in base flow due to mine operations would be difficult to separate from the natural variability of base flow, which has not been measured in the analysis area.

Ramsey Creek. The agencies' numerical model predicts a base flow reduction during mining within and downstream of the CMW. These flow changes would be difficult to measure. In addition, changes in base flow due to mine operations would be difficult to separate from the natural variability of base flow, which has not been measured in the creek.

East Fork Rock Creek. The agencies' numerical model predicts that the base flow of East Fork Rock Creek would be reduced due to mine dewatering. The predicted changes in base flow may be small relative to typical flow in the creek during much of the year. During the September 2007 agency site review, it was apparent that when there is no snow above Rock Lake and there has been no recent precipitation, the only source of surface inflow to Rock Lake is a bedrock spring (SP-31) located above Rock Lake where the Rock Lake fault intercepts East Fork Rock Creek. Changes in base flow in East Fork Rock Creek above Rock Creek Meadows due to mine operations may be measurable during periods similar to September 2007 (base flow periods with little or no snowmelt and dry weather) and may reduce inflow and outflow from Rock Lake. Below Rock Creek Meadows. It may be difficult to separate possible impacts due to mine dewatering from the natural variability of base flow. Changes in base flow at and below Rock

Creek Meadows may be masked by ground water stored in thick alluvium along the middle and lower reaches of East Fork Rock Creek.

East Fork Bull River. The agencies' numerical model predicts a reduction in base flow during mining. The same situation may occur in the upper East Fork Bull River drainage as described above for the upper East Fork Rock Creek drainage. The KNF and DEQ reported spring discharge in a drainage above St. Paul Lake near the trace of the Rock Lake fault in September 2006 at an elevation of about 4,500 feet (McKay 2007). It is not known if the sources of water to this spring (SP-32) are deep ground water and/or discharge from a shallow ground water system. During average to dry years, deeper ground water discharge, assuming such a flow path exists, may be the only source of water to St. Paul Lake when there is no snow above the lake and there has been no recent precipitation. During such periods, the estimated reduction in base flow in the upper reaches of the East Fork Bull River above and below St. Paul Lake as a result of mine dewatering may be measurable. Due to the thick sequences of glacial material located beneath and downstream of St. Paul Lake, it may not be possible to detect such base flow reductions below St. Paul Lake. No flow data are available for the East Fork Bull River within the CMW.

Impacts to Lakes

Because the Libby Lakes are at an elevation of about 7,000 feet, perched above the ground water table, they likely would not be affected by mining activities. Howard Lake is located at an elevation of 4,100 feet, but would be too far from mining activities to be affected by the project. Ramsey Lake, located near the proposed Ramsey Plant Site and the Ramsey Adits, is at an elevation of about 4,450 feet. Ramsey Lake is fed mostly by snowmelt and water flowing in shallow surface deposits in the Ramsey Creek drainage (Wegner, pers. comm. 2008). The lake level varies substantially in Ramsey Lake and it is unlikely that changes in the lake level due to mining would be detectable. In the agencies' conceptual model, Rock Lake is hydraulically connected to the deep bedrock ground water table and is within the area of predicted drawdown during mining. A connection between the deep bedrock ground water system and St. Paul Lake is unknown, but it is possible that spring SP-32 and other springs upgradient of St. Paul Lake below 5,600 feet could be influenced by mining. Due to limited baseline lake level data and water balances for the two lakes, it was not possible to quantify potential changes in lake levels due to mining. The ground water model predicted a decrease in the base flows that contribute to inflows to both lakes and are the only source of inflows during dry periods. Such changes in inflows may result in measurable changes in lake levels only during periods when deep ground water is the only source of water to the lakes (when there is no snowpack above the lakes and no precipitation in the watersheds above the lakes). After additional baseline lake levels are collected to determine the pre-mining variability in the level of Rock Lake, it may be possible to determine if changes in lake level due to mining are separable from natural lake level variability. St. Paul Lake may not be affected similarly by mining because of its location within morainal material, which causes the lake level to fluctuate to a much greater extent than does Rock Lake.

MMC would monitor lake levels in Rock Lake (see section 2.4.5.1, *Hydrology*) and develop a water budget for Rock Lake to determine if mine dewatering affected Rock Lake. MMC would implement monitoring at Rock Lake to measure lake levels that would allow subsequent detection of small changes in lake levels due to possible dewatering effects of the project. Water budget variables would be measured or estimated, including evaporation, precipitation, surface water inflows and outflows, ground water inflows and outflows, and continuous lake levels. The lake monitoring system design and evaluation would be coordinated with the lead agencies.

3.11.4.2.2 Effects of Timber Clearing on Peak Streamflows

The KNF's ECAC model results (KNF 2007b) indicates timber clearing in Alternative 2 may measurably increase the peak flow of Ramsey Creek (Appendix H). The increase in Ramsey Creek peak flow was estimated to be 8 percent. Increased peak flows in other streams would not be measurable.

3.11.4.2.3 Effects of New Road Crossings on Streamflows and Floodplains

Alternative 2 would require three new road crossings across major streams and one new road crossing across a minor stream (Table 88). New roads would cross less than 0.1 acre of floodplain. During construction, disturbances within the floodplain would be minimized. New bridges are proposed over Ramsey and Poorman creeks and a culvert would likely be installed in Little Cherry Creek above the Diversion Dam. After construction is completed, the bridges and culvert would not affect natural streamflows. Table 88 provides information on stream crossings and floodplains that may be affected by the combination of Alternative 2 for the mine and Alternative B for the transmission line.

Table 88. Comparison of Stream and Floodplain Crossings Required for Mine and Transmission Line Alternatives.

Alternative or Combination of Alternatives	Number of Stream Crossings by New Roads		Acres of Flood-plain Crossed	Acres of New Roads within Designated Floodplain	Number of Stream Crossings by Transmission Line	
	Major Stream	Minor Stream			Major Stream	Minor Stream
Mine Alternatives						
2	3	1	<0.1	0	-	-
3	1	1	2.3	0	-	-
4	2	1	0.0	0	-	-
Transmission Line Alternatives						
B	1	4	1.1	1.6	6	16
C	0	3	0.3	0.5	6	13
D	0	5	0.3	0.6	8	13
E	0	4	0.3	<0.1	9	13
Combined Mine and Transmission Line Alternatives						
2 and B	4	5	1.1	1.6	6	16
3 and C	1	4	2.6	0.5	6	13
3 and D	1	6	2.6	0.6	8	13
3 and E	1	5	2.6	<0.1	9	13
4 and C	2	4	0.3	0.5	6	13
4 and D	2	6	0.3	0.6	8	13
4 and E	2	5	0.3	<0.1	9	13

Source: GIS analysis by ERO Resources Corp. using KNF data.

3.11.4.2.4 Effects of Discharges during Construction and Operations

During construction, operations, and post-mining, several analysis area streams would receive additional water from mine-related discharges. Ramsey Creek would receive mine drainage stormwater from the Ramsey Plant Site and Poorman Creek would receive mine drainage stormwater from the Waste Rock Stockpile from storms greater than the 10-year/24-hour storm (estimated to be 2.4 inches). When the LAD Areas were used, Ramsey and Poorman creeks also would receive stormwater from the LAD Areas except from storms less than the 10-year/24-hour storm. MMC's stormwater retention structures would retain stormwater from the 10-year/24-hour storm.

Pumpback wells would intercept all seepage not collected by the underdrain system, so no seepage water would flow from the tailings impoundment to surface water. Mine and adit water discharged at the LAD Areas would first pass through soils underlying the LAD Areas, and then mix with underlying ground water. This time in residence would dampen any sudden increases in streamflows due to this additional water. Ground water beneath the LAD Areas flows to either Ramsey, Poorman, or Libby creeks.

MMC proposes to use slow rate land application for primary treatment of wastewater (MMI 2005a; Geomatrix 2007a; MMC 2008). Land application is the uniform application (usually with sprinklers) of wastewater (for the Montanore Project, mine water not needed for operations) to a vegetated soil surface, with no runoff. The discharged water can receive significant treatment as it flows through the plant root/soil matrix (Environmental Protection Agency 2006b). Water discharged to the LAD Areas would either evapotranspire or percolate to ground water. Water that percolated to ground water would flow downgradient to the nearest stream. MMC has estimated that up to 534 gpm of water would be treated by land application before the water entered nearby streams. MMC anticipates that land application would occur only during the 6-month growing season.

Table 89 provides the Alternative 2 sources and estimated quantities of water to receiving streams, monitoring sites, and the agencies' expected discharge rates to ground water beneath the LAD Areas and the Little Cherry Creek Tailings Impoundment. For the 200-acre LAD Areas in Alternative 2, the estimated maximum application rate at the LAD Areas would be about 130 gpm (see section 3.12.2.3, *Impact Analysis* and section 3.10.4.2.3, *LAD Areas* for further discussion). Based on the agencies' analysis, application rates in excess of 130 gpm to the 200-acre LAD Areas would likely result in surface runoff or the creation of springs in and downgradient of the LAD Areas. The estimated maximum discharge rates to receiving waters provided in Table 89 would be the same during construction, operations, and post-mining. The maximum application rate would depend on site conditions, and would be determined on a performance basis by monitoring both water quality and quantity changes. It is likely that monitoring would determine that the maximum application rate could be higher or lower than estimated by the agencies' analysis. The application rate would be adjusted to meet effluent limits set for discharges at the LAD Areas and to prevent the development of springs in or downgradient of the LAD sites.

The discharges to mine area streams from the LAD Areas would be small, would occur as increased ground water seepage to the stream channels, and would likely not be noticeable even during low flows. The largest percent flow increase (not considering Little Cherry Creek, whose flow would be altered by the tailings impoundment) would be to Ramsey Creek, where the inflow of 14 gpm (0.03 cfs) would be about 2 percent of the $7Q_{10}$ flow (1.4 cfs, see section 3.12.2.3,

Impact Analysis). Surface runoff resulting from storm events would occur with or without the project, but in Alternative 2, runoff from the LAD Areas and Waste Rock Stockpile would be captured in an unlined stormwater retention pond, discharged through an overflow pipe, and then flow overland about 1,500 feet to Poorman Creek. Runoff from the Ramsey Plant Site fill slope would be captured at the toe of the fill, and conveyed through a ditch to a sediment trap and then released overland about 150 feet to Ramsey Creek.

Table 89. Wastewater Sources to Receiving Streams and/or Ground Water and Estimated Maximum Discharge Rates during Construction, Mining, and Post-Mining, Alternative 2.

Water Route and Source	Receiving Stream/ Monitoring Site	Estimated Maximum Discharge Rate (gpm)
Estimated Discharge from LAD Areas to Streams		
Percolation to ground water from LAD Area 1	Ramsey Creek/RA-400	14
Percolation to ground water from LAD Area 2	Ramsey Creek/RA-600	4
	Poorman Creek/PM-1200	9
	Libby Creek/LB-800	5
Stormwater Runoff Subject to Effluent Limitations Guidelines (ELGs) in Streams		
Surface runoff of mine drainage from LAD Areas and Waste Rock Stockpile when exceeds 10-year/24-hour storm event (retention pond capacity)	Poorman Creek/PM-1200	Storm dependent
Surface runoff of mine drainage from plant site when exceeds 10-year/24-hour storm event (retention pond capacity)	Ramsey Creek/RA-200	Storm dependent

The monitoring site listed for each wastewater source is one of many that would be included in a comprehensive monitoring program (see Appendix C for the agencies' proposed surface water, ground water, and aquatic life monitoring).

The percolation rate from the unlined LAD Area stormwater retention pond, based on a 4-acre estimated pond area and Geomatrix's (2007a) long-term infiltration and permeameter tests for the LAD Areas, would be about 230 gpm, assuming that the bottom of the pond is flat and the entire 4 acres is wetted, but no measurable depth has accumulated. If the pond were to fill, the percolation rate would potentially be much higher because of the higher hydraulic head. However, the maximum percolation rate would be limited by how fast ground water could be conveyed away from the retention pond as a ground water mound develops beneath the pond. Assuming that the LAD Area upgradient of the retention pond was being used at or near its maximum capacity, any additional contribution of water to the ground water table via the unlined stormwater retention pond or unlined channel would likely result in ground water discharge in the form of springs to the surface. When the unlined retention pond contained or received water, the application rate to the LAD Area would have to be reduced to account for this additional contribution to ground water below the LAD Area. If the application rate were not reduced, springs would likely surface downhill of the pond on the slope between the pond and Poorman Creek.

3.11.4.2.5 Effects of Diversions during Construction and Operations

Water in Little Cherry Creek above the tailings impoundment would be diverted around the tailings impoundment down to Libby Creek via a 10,800-foot Diversion Channel, which would be designed to divert large flood flows safely around the tailings impoundment. The Diversion Channel would consist of an "engineered" upper channel, and two existing natural drainage channels tributary to Libby Creek. The upper channel would convey the 6-hour Probable Maximum Flood (4,250 cfs) around the tailings impoundment. The upper channel would be about 3,200 feet long, 40 to 60 feet deep, and 19 feet wide at the bottom. Two natural channels would be used to convey water from the upper channel to Libby Creek. The northernmost channel (Channel A) is currently a 6,200-foot long intermittent drainage that flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. The more southerly channel is about 3,000 feet long and rarely contains flowing water.

Surface water within the catchment area of the Seepage Collection Dam and within the tailings impoundment area would be captured and returned to the mill in Ramsey Creek for ore processing. Below the Seepage Collection Dam, the source of water to the former Little Cherry Creek channel would be surface water runoff from the catchment area and ground water discharge below the Seepage Collection Dam.

The flow in the unnamed tributaries of Libby Creek into which upper Little Cherry Creek would be diverted (Channels A and B) would increase and would change from intermittent to perennial flow. The tributaries are not large enough to handle the expected flow volumes and downcutting and increased sediment loading to Libby Creek would be expected as the channel stabilizes. Where possible, MMC would construct some bioengineering and structural features in the two tributary channels to reduce flow velocities, stabilize the channels, and create fish habitat. Short sections of these two channels are very steep, and it may be difficult to access such sections to complete any channel stabilization work. In addition, some sections of these two channels have very thick vegetation that may require clearing, which may create erosion and increase sediment loading to the channels.

An analysis was completed of the effect of Alternative 2 to the Little Cherry Creek watershed area and the resulting change in the flow of area streams (ERO Resources Corp. 2008a in Appendix H). Precipitation and runoff captured by the tailings impoundment and the Seepage Collection Dam would no longer flow to either the diverted or former Little Cherry Creek. During operations, 13 percent of the Little Cherry Creek watershed would continue to contribute flow to the former Little Cherry Creek channel downstream of the Seepage Collection Dam; the estimated $7Q_{10}$ flow would be 0.01 cfs and the estimated average annual flow would be 0.77 cfs. By intercepting ground water, the pumpback well system below the impoundment may further reduce base flow. The flow in Channel A would be about 60 percent of the flow of the original Little Cherry Creek. The estimated $7Q_{10}$ flow of the water diverted to Channels A and B would be 0.16 cfs. The analysis also evaluated the potential changes in the watershed areas contributing to the flow of Bear Creek and Libby Creek. For Bear Creek and Libby Creek, the change in the watershed areas that would contribute water to Bear Creek and Libby Creek near the tailings impoundment would be 3 percent or less.

3.11.4.2.6 Effects of Pumping from Make-up Wells

In Alternative 2, make-up water requirements would be about 135 gpm at a steady-state mine inflow rate of 800 gpm. If the agencies' modeled inflows of 450 gpm were more representative of

actual mine inflows, 485 gpm of make-up water would be needed. If total mine/adit inflow were not adequate to supply water for process purposes, MMC may be able to use water from pumpback wells located below the tailings impoundment for make-up purposes. Ground water wells for make-up water may also be needed. MMC has not identified specific well locations; the most likely location would be along a major drainage, such as Libby Creek upstream of LB-2000. MMC would notify the lead agencies if long-term make-up water were necessary. MMC would modify the aquatic life monitoring plan to take into account such withdrawals. Withdrawals would not proceed until the lead agencies' approval of an updated aquatic life monitoring plan. MMC would need to conduct appropriate pumping tests, and acquire the appropriate water rights from the DNRC during final design. Assuming that all of the pumped water would be coming from Libby Creek (which would be the case during steady-state pumping from Libby Creek alluvium), the effect on flow in Libby Creek may be measurable during low flow periods such as August and September. The lower value of 135 gpm (0.3 cfs) would be about 4 percent and the higher value of 485 gpm would be about 15 percent of the model-predicted base flow of the creek at LB-2000 (ERO Resources Corp. 2008b).

3.11.4.2.7 Integrated Effects to Libby Creek Streamflows during Construction and Operations

Mine facilities would alter flow in Libby Creek and its tributaries through diversions and discharges discussed in the previous sections. The integrated effects of these flow changes during November through March are shown in Table 90. The values shown in Table 90 are based on calculated average flows in area streams, and assume 450 gpm of mine and adit inflows. Predicted flow changes would be greater during lower flow periods and less in higher flow periods, and would vary slightly from the changes shown in Table 90 if mine and adit inflows differed from the agencies' inflow estimate of 450 gpm.

3.11.4.2.8 Post-Operations Effects

Effects of Mine Inflows

After the completion of mining and plugging of the adits, the mine void would fill with water. The agencies estimate that it would take about 70 years for the ground water level to return to steady state conditions (see section 3.10.4.2.1, *Mine Area*). The agencies' numerical ground water model predicts that water from the mine void would flow toward the East Fork Bull River after filling of the mine void, resulting in a flow increase in the East Fork Bull River. Prior to filling of the mine void, reductions in base flow in the East Fork Bull River would continue, but would diminish over time after the mine void was filled. The model also predicts a small flow increase in Ramsey Creek throughout its length and in the upper portion of Libby Creek within the CMW. In lower portions of Libby Creek and in all of East Fork Rock Creek, base flows are predicted to decrease slightly (ERO Resources Corp. 2008a). Base flow into Rock Lake after the mine void filled is predicted in the agencies' numerical model to be less than during pre-mining conditions, but more than during mining. St. Paul Lake may receive slightly higher recharge from ground water post-mining than pre-mining and mining conditions.

Effects of Discharges

After site reclamation, discharges of stormwater from the LAD Areas to Poorman Creek or from the Ramsey Plant Site to Ramsey Creek would no longer be subject to ELGs. Pumping of water from the mine would cease, and the adits would be plugged.

Table 90. Estimated Changes in Average Flow During November through March in Libby Creek, Alternative 2.

Variable	Estimated Change (cfs)	Source
Estimated Changes @ LB-800		
Mine inflow from Ramsey Creek	-0.05	ERO Resources Corp. 2008a
Mine inflow from Libby Creek	-0.34	ERO Resources Corp. 2008a
Potable water @ mill (11 gpm)	-0.02	Water balance (Table 8)
Estimated change @ LB-800	-0.41	
Estimated average winter flow @ LB-800	26	LB-800 watershed is 23.9 mi^2; 23.9*1.09 cfs/mi^2 = 26.1 cfs
Percent change in flow	**-2%**	
Estimated Changes @ LB-2000		
Estimated change @ LB-800	-0.41	
Tailings Evaporation/Diversion[†]	-1.23	See note; Appendix H
Make-up water	-1.08	Water balance (Table 8)
Estimated change @ LB-2000	-2.72	
Estimated average winter flow @ LB-2000	44	LB-2000 watershed is 40.7 mi^2; 40.7*1.09 cfs/mi^2 = 44.4 cfs
Percent change in flow	**-6%**	

[†]Flow reduction calculated from watershed analysis (Appendix H) and estimated average winter flow. During operations, water from 720 acres would be diverted to mill. Calculated average winter flow at Granite and Flower creeks is 1.09 cfs/mi^2. Therefore, estimated flow reduction is 1.09 cfs/mi^2 * 720 acres * 1 mi^2/640 acres = 1.23 cfs.

MMC estimates 930 gpm of tailings water would be collected by the underdrain system beneath the impoundment at closure, 200 gpm after 10 years and 50 to 100 gpm for a longer period (Klohn Crippen 2005). Runoff from the Main and Saddle dams would be diverted to the Seepage Collection Pond and would be managed until the dams were reclaimed. Post-operations, this water would be discharged at the LAD Areas, recycled to the impoundment, or treated at the Libby Adit Water Treatment Plant. Based on the agencies' analysis, the LAD Areas in Alternative 2 would be able to accept up to about 130 gpm of water for treatment during the 6-month growing season. The estimated maximum discharge rates to receiving waters are provided in Table 89. The application rate would depend on site conditions and would be adjusted to meet surface and ground water quality standards, BHES Order limits, and MPDES permit limits (see section 3.12.1.2, *Applicable Regulations and Standards*).

Seepage from the tailings impoundment into the underlying ground water is estimated to decrease from 25 gpm to 17 gpm in the first 10 years after closure, stabilizing at 5 gpm over the long term (Klohn Crippen 2006). Tailings seepage not intercepted by the underdrain system would mix with ground water and be collected by pumpback recovery wells for return to the tailings impoundment until applicable standards were met.

MMC would maintain and operate necessary wastewater management facilities until water quality standards and MPDES permit limits were met, without treatment, in all receiving waters from any discharge. Long-term treatment may be required. A MPDES permit would contain effluent limits and required monitoring for both receiving water and effluent quality. As long as

post-closure water treatment operates, the agencies would require a bond for the operation and maintenance of the water treatment plant. The level of human activity associated with facility operation, maintenance and monitoring is unknown, but has the potential of being a daily requirement and year-round in duration. The length of time that the second phase of closure activities would occur is not known, but may be decades or more.

Effects of Diversions

After the impoundment was reclaimed and runoff was no longer subject to ELGs, runoff from the reclaimed tailings impoundment surface and the watershed west of the impoundment would be routed toward Bear Creek. After the Main Dam was reclaimed and runoff was no longer subject to ELGs, a small portion of the north Main Dam abutment would be in the Bear Creek watershed and some runoff would flow to Bear Creek. The Bear Creek watershed area where runoff would meet the creek would increase by 560 acres, potentially increasing the flow in Bear Creek by 5 percent or less (ERO Resources Corp. 2008a). The larger watershed would increase runoff during stormwater runoff and would not affect base flows.

The Little Cherry Creek Diversion Channel would remain in place, routing surface water runoff in the upper Little Cherry Creek watershed in the Diversion Channel to Libby Creek. After the Main Dam and South Saddle Dam were reclaimed and runoff was no longer subject to ELGs, runoff from the South Saddle Dam and the south Main Dam abutment would flow to the Diversion Channel. Runoff from the Main Dam face would flow to the former Little Cherry Creek drainage. Post-mining, 26 percent of the Little Cherry Creek watershed area would continue to contribute flow to former Little Cherry Creek downstream of the Seepage Collection Dam (ERO Resources Corp. 2008a); the estimated $7Q_{10}$ flow of the creek would be about 0.02 cfs and the estimated average annual flow of the creek would be about 1.5 cfs. Average flows in the diverted Little Cherry Creek (Channel A) would be about 55 percent of the flow in the original Little Cherry Creek. For a short segment of Libby Creek between Channel A and Bear Creek, the change in the watershed areas that would contribute water to Libby Creek would be 3 percent or less. Below Bear Creek, flows in Libby Creek would return to pre-mining conditions, less any reduced base flows (predicted by the agencies to be immeasurable).

3.11.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

In Alternative 3, four mine facilities would be located in alternative locations. MMC would develop an impoundment site north of Poorman Creek for tailings disposal, use a plant site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed operating permit area and disturbance area at LAD Areas 1 and 2 (Figure 32).

The Libby Plant Site would be built of fill material from a large cut on the west side of the plant site. Based on preliminary analysis, the cut and fill materials would be balanced, and waste rock would not be used in plant site construction. Avoiding the use of waste rock in plant site construction would address the issue of stormwater runoff from the plant site possibly adversely affecting the water quality of nearby water resources. For MPDES permitting purposes, stormwater runoff from a plant site constructed of waste rock would be subject to ELGs and would be considered mine drainage. If the plant site were not built with waste rock, runoff would be considered stormwater and ELGs would not apply for MPDES permitting.

In Alternative 3, the proposed water management plan would be modified to address the uncertainties about quality of the mine and adit inflows and the effectiveness of LAD for primary treatment. If necessary, MMC would use either the Libby Adit Treatment Plant for primary treatment of all excess mine and adit water or a pretreatment system just for primary treatment of nitrate prior to any discharge to the LAD Areas. The LAD Areas would be used for secondary or polishing treatment and disposal. Any direct discharges to Libby Creek would require additional treatment based on effluent water quality and MPDES requirements.

3.11.4.3.1 Effects of Inflows During Construction and Mining

Changes in Creek Base Flow Due to Mining

Changes to creek base flows as a result of mining would be similar to those described in Alternative 2 (section 3.11.4.2.1, *Effects of Inflows During Construction and Mining*). In Alternative 3, two adits in addition to the Libby Adit would be in the Libby Creek drainage near the existing Libby Adit. The Ramsey Adits would not be constructed. Changes in base flow in Ramsey Creek would be nearly zero and not measurable in Alternative 3. Three adits in the Libby Creek drainage may increase the reductions in base flow in Libby Creek predicted for Alternative 2, but the changes would be relatively small, and would depend on the additive effect of two additional adits parallel to the existing Libby Adit. The ground water drawdown resulting from inflow to each of the three adits would overlap. As a result, the total water production of the three adjacent adits would be much less than the Libby Adit in the Libby Creek drainage and the two Ramsey Adits in the Ramsey Creek drainage.

Impacts to Lakes

Effects to lakes in the CMW would be the same as those described in Alternative 2 (section 3.10.4.2.1, *Mine Area*). Ramsey Lake would not be affected because the production adits would be in the Libby Creek drainage. Lake monitoring would be implemented at Rock Lake, St. Paul Lake, and the Libby Lakes as soon as possible prior to mining to assist in developing the baseline water balance of the lakes. Major water budget variables would be accounted for and/or estimated, including evaporation, seepage, precipitation and surface water inflows and outflows, as well as continuously recorded lake levels. The lake monitoring system design and evaluation would be coordinated with the agencies. The same monitoring (Appendix C) would occur during mining to determine whether the lake levels were affected during mining operations.

3.11.4.3.2 Effects of Timber Clearing on Streamflows

Based on the ECAC model results (Appendix H), timber clearing is not predicted to measurably increase the peak flow of any mine area streams.

3.11.4.3.3 Effects of New Road Crossings on Streamflows and Floodplains

Alternative 3 would require one new road crossing over a major stream and one new road crossing over a minor stream (Table 88). It is estimated that new roads would cross 2.3 acres of floodplain. During construction, disturbances within the floodplain would be minimized. After construction is completed, the bridges and culvert would not affect natural streamflows. Table 88 provides information on stream crossings and floodplains that may be affected by the combination of Alternative 3 for the mine and Alternatives C, D or E for the transmission line.

3.11.4.3.4 Effects of Discharges during Construction and Mining

In Alternative 3, the sources and routes of water to receiving streams would be the same as Alternative 2 (Table 91); the agencies' expected application rate at the LAD Areas, discharge

rates to ground water beneath the LAD Areas would be slightly higher. In this alternative, the size of the LAD Areas would be 307 acres, while the maximum application rate is estimated to be 198 gpm (see sections 3.12.2.3, *Impact Analysis* and 3.10.4.3.3, *LAD Areas* for further discussion). Additional mine water would be sent to the Libby Adit Water Treatment Plant and would be discharged under the existing Libby Adit MPDES permit. The maximum discharge rates to receiving waters provided in Table 91 would be the same during construction, operations, and post-mining. As in Alternative 2, discharge rates would vary based on the site-specific hydrogeologic conditions under and downgradient of the LAD Areas and effluent limits set for discharges at the LAD Areas.

Table 91. Wastewater Sources to Receiving Streams and/or Ground Water and Estimated Maximum Discharge Rates during Construction, Mining, and Post-Mining, Alternative 3.

Water Route and Source	Receiving Stream/ Monitoring Site	Estimated Maximum Discharge Rate (gpm)
Estimated Discharge from LAD Areas to Streams		
Percolation to ground water from LAD Area 1	Ramsey Creek/RA-400	18.5
	Poorman Creek/PM-1000	3.4
Percolation to ground water from LAD Area 2	Ramsey Creek/RA-600	11
	Poorman Creek/PM-1200	10.7
	Libby Creek/LB-800	3.7
Stormwater Runoff Subject to ELGs in Streams		
Surface runoff of mine drainage from LAD Areas when exceeds 10-year/24-hour storm event (retention pond capacity)	Poorman Creek/PM-1200	Storm dependent

The monitoring site listed for each wastewater source is one of many that would be included in a comprehensive monitoring program (see Appendix C for the agencies' proposed surface water, ground water, and aquatic life monitoring).

The discharges to mine area streams from the LAD Areas would be small, would occur as increased ground water seepage to the stream channels, and would likely not be measurable. The largest percent flow increase would be to Ramsey Creek, where the discharge of 18.5 gpm (0.04 cfs) from the LAD Areas would be about 3 percent of the $7Q_{10}$ flow (1.4 cfs, see section 3.12.2.3, *Impact Analysis*) of Ramsey Creek. In Alternative 3, stormwater runoff from the LAD Areas would be captured in a lined stormwater retention pond, and discharged to Poorman Creek via a constructed channel designed to minimize erosion.

3.11.4.3.5 Effects of Diversions during Construction and Mining

The Poorman Tailings Impoundment would be located in two intermittent drainages. This alternative would not require the diversion of Little Cherry Creek or Poorman Creek. Any flow within the watershed above the impoundment would be routed to Poorman or Little Cherry creeks. Water from a 146-acre watershed above the Poorman Tailings Impoundment would be diverted to Poorman Creek, increasing the watershed of Poorman Creek by about 4 percent (ERO Resources Corp. 2008a). Water from an 80-acre watershed above the Poorman Tailings Impoundment would be diverted to Little Cherry Creek, an increase of about 8 percent in the Little Cherry Creek watershed. Because the flows in the drainages are intermittent and watershed

areas are small, flow rates are expected to be small. As in Alternative 2, precipitation intercepted by the impoundment and runoff from the dam would be intercepted and used in the mill. The watersheds of the drainages in the Poorman Impoundment Site (Channels A and B) would be reduced by about 85 percent during operations. Flows in Channels A and B, which are currently intermittent, would rarely occur during operations. The change in watershed areas that would contribute water to the Libby Creek watersheds would be 3 percent or less.

3.11.4.3.6 Effects of Pumping from Make-up Wells

In Alternative 3, make-up water requirements would be about 50 gpm at a steady-state mine inflow rate of 450 gpm. Make-up wells would not be needed at steady-state inflows greater than about 500 gpm or if the needed water were supplied by the pumpback wells. If needed to provide any necessary make-up water requirements, a water supply well field located north of the Seepage Collection Pond would draw from Libby Creek alluvial ground water (Figure 26). As in Alternative 2, MMC would notify the lead agencies if long-term make-up water were necessary. In Alternatives 3 and 4, MMC would likely withdraw ground water for operational use during the high flow months of April through July, but may withdraw water during other months except when flows are low. MMC would modify the aquatic life monitoring plan to take into account such withdrawals. Withdrawals would not proceed until the lead agencies' approval of an updated aquatic life monitoring plan. MMC would need to conduct appropriate pumping tests, and acquire the appropriate water rights from the DNRC during final design. The effect on flow in Libby Creek would likely not be measurable. During steady-state pumping, when all of the 50 gpm pumped from the make-up wells would come directly from surface flows in Libby Creek, 50 gpm (0.11 cfs) would be less than 1 percent of the model-predicted base flow of the creek at LB-2000 (ERO Resources Corp. 2008b).

3.11.4.3.7 Integrated Effects to Libby Creek Streamflows during Construction and Operations

Mine facilities would alter flow in Libby Creek and its tributaries through diversions and discharges discussed in the previous sections. The integrated effects of these flow changes are provided in Table 92. Assumptions described previously for Alternative 2 (Table 90) apply to Alternative 3.

3.11.4.3.8 Post-Operations Effects

Effects of Mine Inflows

The effect of mine inflows post-operations would be similar to Alternative 2 (section 3.11.4.2.8, *Post-Operations Effects*). The base flow of Ramsey Creek after mining probably would not change. In addition, if hydrologic modeling during initial mine operations (by Year 5 of operations) determined that one or more bulkheads were necessary to minimize changes in East Fork Rock Creek and East Fork Bull River streamflows, as well as lake levels in Rock Lake, MMC would submit a plan for bulkheads to the agencies for approval. One or more bulkheads would be maintained underground, if necessary, after the plan's approval.

Effects of Discharges

After site reclamation, discharges of stormwater from the LAD Areas to Poorman Creek would no longer be subject to ELGs. Post-closure management of tailings water would be the same as Alternative 2 (section 3.11.4.2.8, *Post-Operations Effects*). The subsurface materials at the Poorman Impoundment Site are similar to those at the Little Cherry Creek Impoundment Site, and seepage rates would be expected to be similar.

Table 92. Estimated Changes in Average Flow During November through March in Libby Creek, Alternative 3.

Variable	Estimated Change (cfs)	Source
Estimated Changes @ LB-800		
Mine inflow from Libby Creek	-0.39	ERO Resources Corp. 2008a
Potable water @ mill (11 gpm)	-0.02	Water balance (Table 8)
Estimated change @ LB-800	-0.41	
Estimated average winter flow @ LB-800	26	LB-800 watershed is 23.9 mi^2; 23.9*1.09 cfs/mi^2 = 26.1 cfs
Percent change in flow	**-2%**	
Estimated Changes @ LB-2000		
Estimated change @ LB-800	-0.41	
Tailings Evaporation/Diversion†	-1.04	See note; Appendix H
Make-up water	-0.11	Water balance (Table 8)
Estimated change @ LB-2000	-1.56	
Estimated average winter flow @ LB-2000	44	LB-2000 watershed is 40.7 mi^2; 40.7*1.09 cfs/mi^2 = 44.4 cfs
Percent change in flow	**-4%**	

†Flow reduction calculated from watershed analysis (Appendix H) and estimated average winter flow. During operations, water from 611 acres would be diverted to mill, which is 85% of the area diverted by Alternative 2. Calculated average winter flow at Granite and Flower creeks is 1.09 cfs/$mile^2$. Therefore, estimated flow reduction is 1.09 cfs/mi^2 * 611 acres * 1 mi^2/640 acres = 1.04 cfs.

Effects of Diversions

After the impoundment was reclaimed and runoff was no longer subject to ELGs, runoff from the reclaimed Poorman Tailings Impoundment surface would be routed toward Little Cherry Creek. The watershed area of Little Cherry Creek would increase by 644 acres, an increase of 38 percent (ERO Resources Corp. 2008a). Average annual flows in Little Cherry Creek would increase by similar percentages. The larger watershed would increase runoff during stormwater runoff and would not affect base flows. After the Main Dam was reclaimed and runoff no longer subject to ELGs, runoff would flow to Poorman Creek, or Libby Creek via Channels A or B. Changes in the watershed areas contributing water to Poorman and Libby Creek would be 3 percent or less. Below Little Cherry Creek, flows in Libby Creek would return to pre-mining conditions, less any reduced base flows (predicted by the agencies to be immeasurable).

3.11.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment Site as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. The amount of seepage collected by the seepage collection system, which includes seepage from the tailings impoundment, may be increased by better locating the Seepage Collection Dam with respect to the local geologic conditions. Any tailings seepage not intercepted by the drains beneath the

impoundment and dams would likely discharge to the former Little Cherry Creek watershed through the fractured bedrock aquifer. Consequently, siting the Seepage Collection Dam at or below the location where bedrock outcrops in the Little Cherry Creek drainage would increase the likelihood that the seepage would be collected by the dam. In Alternative 4, MMC would conduct additional geotechnical work near the Seepage Collection Dam during final design and site the dam lower in the drainage if technically feasible. Pumpback wells would intercept tailings impoundment seepage not intercepted by the underdrain system before it reached surface water.

3.11.4.4.1 Effects of Inflows During Construction and Mining

Changes in Creek Base Flow Due to Mining

Changes to creek base flows as a result of mining would be the same as those described in Alternative 3 (section 3.11.4.3.1, *Effects of Inflows During Construction and Mining*).

Impacts to Lakes

Effects on lakes and monitoring would be the same as Alternatives 3 (section 3.11.4.3.1, *Effects of Inflows During Construction and Mining*).

3.11.4.4.2 Effects of Timber Clearing on Streamflows

Based on the ECAC model results (Appendix H), timber clearing is not predicted to measurably increase the peak flow of any mine area streams.

3.11.4.4.3 Effects of New Road Crossings on Streamflows and Floodplains

Alternative 4 would require two new road crossings over major streams and one road crossing over a minor stream (Table 88). No floodplains would be crossed by new roads. During construction, disturbances within the floodplain would be minimized. After construction is completed, the bridges and culvert would not affect natural streamflows. Table 88 provides information on stream crossings and floodplains that may be affected by the combination of Alternative 4 for the mine and Alternatives C, D, or E for the transmission line.

3.11.4.4.4 Effects of Discharges during Construction and Mining

The effects to Ramsey, Poorman, and Libby creeks due to stormwater discharges and discharges from the LAD Areas would be same as Alternative 3 (section 3.11.4.3.4, *Effects of Discharges during Construction and Mining*).

3.11.4.4.5 Effects of Diversions during Construction and Mining

The effect of diversions on the streamflows in former Little Cherry Creek, Channel A, and Bear Creek would be the same as described for Alternative 2 (section 3.11.4.2.5, *Effects of Diversions during Construction and Operations*).

3.11.4.4.6 Effects of Pumping from Make-up Wells

Effects due to pumping from the make-up wells would be the same as Alternative 3 (section 3.11.4.3.6, *Effects of Pumping from Make-up* Wells). The effect on flow in Libby Creek would not be measurable during the high flow months and would be about 2 percent of the estimated average winter flow of the creek at LB-2000 (Table 93).

3.11.4.4.7 Integrated Effects to Libby Creek Streamflows during Construction and Operations

Mine facilities would alter flow in Libby Creek and its tributaries through diversions and discharges discussed in the previous sections. The integrated effects of these flow changes are provided in Table 93. Assumptions described previously for Alternative 2 (Table 90) apply to Alternative 4.

Table 93. Estimated Changes in Average Flow During November through March in Libby Creek, Alternative 4.

Variable	Estimated Change (cfs)	Source
Estimated Changes @ LB-800		
Mine inflow from Libby Creek	-0.39	ERO Resources Corp. 2008a
Potable water @ mill (11 gpm)	-0.02	Water balance (Table 8)
Estimated change @ LB-800	-0.41	
Estimated average winter flow @ LB-800	26	LB-800 watershed is 23.9 mi^2; 23.9*1.09 cfs/mi^2 = 26.1 cfs
Percent change in flow	**-2%**	
Estimated Changes @ LB-2000		
Estimated change @ LB-800	-0.41	
Tailings Evaporation/Diversion[†]	-1.23	See note; Appendix H
Make-up water	-1.08	Water balance (Table 8)
Estimated change @ LB-2000	-2.72	
Estimated average winter flow @ LB-2000	44	LB-2000 watershed is 40.7 mi^2; 40.7*1.09 cfs/mi^2 = 44.4 cfs
Percent change in flow	**-6%**	

[†]Flow reduction calculated from watershed analysis (Appendix H) and estimated average winter flow. During operations, water from 720 acres would be diverted to mill. Calculated average winter flow at Granite and Flower creeks is 1.09 cfs/$mile^2$. Therefore, estimated flow reduction is 1.09 cfs/mi^2 * 720 acres * 1 mi^2/640 acres = 1.23 cfs.

3.11.4.4.8 Post-Operations Effects

Effects of Inflows and Discharges

The effect of mine inflows after mining would be the same as Alternative 3 (section 3.11.4.3.8, *Post-Operations Effects*). Management of stormwater and other discharges would be the same as Alternative 3 (section 3.11.4.3.8, *Post-Operations Effects*).

Effects of Diversions

After the impoundment surface was reclaimed and runoff was no longer subject to ELGs, runoff from the reclaimed tailings impoundment surface would be routed via the permanent Diversion Channel and Channel A to Libby Creek (as compared to Alternative 2, where runoff from the reclaimed tailings impoundment surface would flow toward Bear Creek). After the dams were reclaimed and runoff was no longer subject to ELGs, runoff from the South Saddle Dam and the south Main Dam abutment would flow to the Diversion Channel. Consequently, the watershed of Channel A would increase by about 500 acres post-mining, compared to operational conditions.

This additional area may require MMC to complete more channel stabilization work in Channel A due to increased flows, plus follow-up monitoring. Average annual flow in the diverted Little Cherry Creek would be about five times the existing flow in Channel A, but about 10 percent less than the current flow of Little Cherry Creek (Appendix H).

After the dams were reclaimed and runoff from them was no longer subject to ELGs, runoff from the Main Dam would flow to the former Little Cherry Creek channel, not to Bear Creek. Post-mining, the watershed area contributing water to the former Little Cherry Creek channel would decrease by 85 percent (compared with the pre-mining watershed area) directly below the tailings impoundment and by 74 percent (compared with the pre-mining watershed area) at the confluence of former Little Cherry and Libby creeks. Changes in the watershed areas contributing flow to Bear and Libby Creek would be 5 percent or less. Below Bear Creek, flows in Libby Creek would return to pre-mining conditions, less any reduced base flows (predicted by the agencies to be immeasurable).

3.11.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Possible impacts to streams due to construction, operation, and maintenance of a new transmission line would not occur.

3.11.4.6 Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)

Alternative B transmission line would have six major stream crossings: Hunter Creek, the Fisher River, an unnamed tributary to Miller Creek, Howard Creek, Libby Creek, and Ramsey Creek. The alignment also would have 16 new crossings over minor streams. Three new road crossings over major streams and one new road crossing over a minor stream would be required. The transmission line would cross 1.1 miles of floodplains and require 1.6 acres of new roads within a floodplain (Table 88). Eight structures would be located in a floodplain. Construction would be curtailed during heavy rains or high winds to prevent erosion to streams. MMC identified four possible stream crossings: fords, culverts, arches, and bridges. Culverts would be the most commonly used crossing method. Because the construction time of the line would be short, MMC anticipates that no drainage would be provided for the temporary roads, but would follow the agencies' guidance if installation of culverts were required. Culvert installations on perennial streams would meet BMP requirements. In all transmission line alternatives, the DEQ would require on-site inspections of stream crossings associated with the 230-kV transmission line to determine the most suitable crossing methods and timing of construction that would minimize impacts on floodplains and streamflow (see Environmental Specifications in Appendix D). As proposed, culverts would remain after the project was completed. During construction, streamflows may be temporarily dammed or routed around construction activities. Damming the stream would reduce or eliminate flow below the dam for a short period of time. After construction is completed, the culverts would not affect natural streamflows.

Based on the ECAC model results (Appendix H), the combination of Alternative 2 and Alternative B would increase peak flow in Ramsey Creek by 8.6 percent. Other peak streamflow increases are predicted to be small and would not be measurable.

3.11.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Six stream major streams would be crossed by the transmission line in this alternative: Sedlak Creek, Hunter Creek, Fisher River, an unnamed tributary to Miller Creek, Howard Creek, and Libby Creek. The transmission line would cross an estimated 0.3 mile of floodplains and require 0.5 acre of new roads within a floodplain (Table 88). One structure would be located in a floodplain. Alternative C would require no new roads crossings over major streams, and three new road crossings over minor streams. Culverts would be installed, if needed, on roads used for maintenance access. Other aspects of stream crossings, such as compliance with the Environmental Specifications in Appendix D, would be the same as Alternative B (section 3.11.4.6, *Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)*).

In Alternatives C, D, and E, installation of culverts, bridges, or other structures at stream crossings would be specified by the agencies following on-site inspections with DEQ, FS, FWP, and local conservation districts. Installation of culverts or other structures in a water of the United States would be in accordance with the U.S. Army Corps of Engineers 404 and DEQ 318 permit conditions. All culverts would be sized according to Revised Hydraulic Guide KNF (1990) and amendments. Where new culverts were installed, they would be installed so water velocities or positioning of culverts would not impair fish passage. Stream crossing structures would be able to pass the 100-year flow event.

After line installation was completed, access roads would be changed to intermittent stored service (section 2.9.3.2, *Access Road Construction and Use*). Culverts would be removed by the KNF if determined to be high risk for blockage or failure. Stream banks would be laid back to allow streamflows to pass without scouring or ponding. Transmission line roads would be decommissioned after mine closure and removal of the transmission line. Culverts would be removed and fill areas sloped back and stabilized during road decommissioning.

Based on the KNF ECAC model results (Appendix H), timber clearing for access roads and the transmission line is not predicted to measurably increase the peak flow of any streams.

3.11.4.8 Alternative D – Miller Creek Transmission Line Alternative

Eight major streams would be crossed by the transmission line in this alternative: Sedlak Creek, Hunter Creek, Fisher River, an unnamed tributary to Miller Creek, Miller Creek, Howard Creek (at two locations), and Libby Creek. The transmission line would cross an estimated 0.3 mile of floodplains and require 0.6 acre of new roads within a floodplain (Table 88). Two structures would be located in a floodplain. Alternative D would require no new road crossings over major streams, and five new road crossings over minor streams. Road and culvert construction, maintenance and removal, and effects on peak flows would be the same as Alternative C (section 3.11.4.7, *Alternative C – Modified North Miller Creek Transmission Line Alternative*).

3.11.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

Nine major streams would be crossed by the transmission line in this alternative: Sedlak Creek, Hunter Creek, Fisher River, West Fisher Creek, two unnamed tributaries to West Fisher Creek, Howard Creek (at two locations) and Libby Creek. The transmission line would cross an estimated 0.3 mile of creek floodplains and require less than 0.1 acre of new roads within a floodplain (Table 88). One structure would be located in a floodplain. The alternative would require no new road crossings over major streams, and four new crossings over minor streams.

Road and culvert construction, maintenance and removal, and effects on peak flows would be the same as Alternative C (section 3.11.4.7, *Alternative C – Modified North Miller Creek Transmission Line Alternative*).

3.11.4.10 Cumulative Effects

Cumulative effects in the analysis area include past and current actions that are likely to continue in the future and reasonably foreseeable actions that could affect streamflows, spring flows, and lake levels. This includes other area mining activities, particularly instream suction dredging and placer exploration, which in the past have created physical substrate habitat alterations in area streams. Suction dredging tends to destabilize stream channels and may alter streamflows, particularly during high flows. Mine reclamation activities are also ongoing and planned. Other activities that could affect surface water flows include timber harvesting, land clearing, home construction, road construction, septic field installation, water well drilling, livestock grazing, and stream channel and bank stabilization or restoration projects. These activities could either increase or reduce water sources to streams, springs and lakes; other than the Montanore and Rock Creek Projects, cumulative effects would be minor.

3.11.4.10.1 Effects of Mine Inflows to Montanore and Rock Creek Projects

The Montanore and Rock Creek Projects would cumulatively affect base flows in the East Fork Rock Creek and East Fork Bull River. No other aspects of the two projects would have cumulative effects on surface water resources.

The agencies' numerical model predicted that the cumulative change in base flows in East Fork Rock Creek from the headwaters to about 1.25 miles downstream of Rock Lake would be identical to change that would occur with operation of only the Montanore Project. Below this location, model-predicted base flow reductions would be greater with operation of the Rock Creek Project. Changes in base flow in East Fork Rock Creek due to mine operations may be measurable. Below Rock Creek Meadows, it may be difficult to separate possible impacts due to mine dewatering from the natural variability of base flow. Changes in base flow at and below Rock Creek Meadows may be masked by ground water stored in thick alluvium along the middle and lower reaches of East Fork Rock Creek.

The agencies' numerical model predicted base flow reductions would be greater cumulatively throughout the length of the East Fork Bull River (up to 300 gpm less) during mining and post-mining (up to 60 gpm less). It may be possible to measure base flow changes due to mining that may occur during mining operations of one or both mines.

3.11.4.11 Regulatory/Forest Plan Consistency

The proposed activities in Alternatives 2, 3, and 4 are consistent with the KFP for water resources. Because construction, operation, and closure of the mine and transmission line under all alternatives would be in compliance with all applicable water quality standards and permit requirements, the chosen mine and transmission line alternatives would be in compliance with the Montana Water Quality Act.

3.11.4.12 Irreversible and Irretrievable Commitments

During operations, use of mine and adit inflows and any water needed for make-up or potable water would be an irretrievable commitment of resources. Any change in stream or spring flow or lake levels during or after mining would be an irreversible commitment of resources.

The tailings impoundment in the Little Cherry Creek watershed in Alternatives 2 and 4 would permanently alter the flow in Little Cherry Creek, Bear Creek (Alternative 2 only), Libby Creek, and unnamed tributaries to Libby Creek. Alternative 3 would alter the flow in the Little Cherry Creek, Poorman Creek, Libby Creek, and unnamed tributaries to Libby Creek. These flow changes would be an irreversible commitment of surface water resources.

3.11.4.13 Short-Term Uses and Long-Term Productivity

The short-term use of surface water resources would be the use of project streams for discharge of treated mine and adit water in the various alternatives. Changes that may occur that would affect the long-term productivity of surface water resources include:

- Changes in stream and spring flows, as well as changes in the levels of Rock and St. Paul lakes that may occur due to mine inflows
- Changes to watersheds (and the streams and springs within them) that would be permanently covered by the alternative tailings impoundment sites
- Changes in streamflows that would occur due to permanent stream diversions around or from the alternative tailings impoundment sites

3.11.4.14 Unavoidable Adverse Environmental Effects

Based on the agencies' conceptual model of the connection of surface and ground water in the analysis area, mining of the ore body may unavoidably reduce streamflows and spring flows, and deep ground water inflow to Rock Lake. A change in deep ground inflow to Rock Lake may affect the level of Rock Lake.

3.12 Surface Water Quality

3.12.1 Regulatory Framework

The Montana DEQ is responsible for enforcing compliance with water quality laws on all lands in Montana, excluding Tribal lands. The Forest Service has a Memorandum of Understanding with the State that allows the Forest Service and DEQ to work collaboratively to address water quality issues on National Forest System lands. The 1987 KFP established management areas within the forest with different goals and objectives based on the capabilities of lands within this area (USDA Forest Service 1987).

3.12.1.1 Permits and Authorizations Held by MMC

3.12.1.1.1 Board of Health and Environmental Sciences Order No. 93-001-WQB

Section 1.3.2.2, *Water Quality-Related Approvals* discusses previous water quality related approvals associated with the Montanore Project. Pursuant to the 1971 nondegradation statute and regulations then in effect, Noranda submitted a “Petition for Change in Quality of Ambient Waters” in 1989 to the BHES requesting an increase in the concentration of select constituents in surface and ground water above ambient concentrations. Noranda submitted supplemental information to support the petition in 1992. Under the 1971 statute, any change in surface or ground water quality above ambient concentrations was prohibited, no matter how small the effect, unless the BHES determined that the changes did not preclude present or anticipated uses of water resources, and were justified as a result of necessary social or economic development.

Noranda submitted a “Petition for Change in Quality of Ambient Waters” in 1989 to the BHES requesting an increase in the concentration of select constituents in surface and ground water above ambient water quality, as required by Montana's 1971 nondegradation statute. Supplemental information to support the petition was submitted by Noranda in 1992. In response to Noranda’s petition, the BHES issued an Order in 1992 (BHES 1992). The Order is presented in Appendix A. The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese and zinc in both surface and ground water, as well as nitrate (ground water only) and total inorganic nitrogen (surface water only) (Table 94). These nondegradation limits apply to all surface and ground water affected by the Montanore Project and remain in effect during the operational life of the mine and for so long thereafter as necessary (BHES 1992).

The Order also indicates that land treatment, as then proposed and currently proposed in Alternative 2, would satisfy the state requirement to treat industrial wastes using technology that is the best practicable control technology available. In 1992, the DHES (now DEQ) determined that land treatment would provide adequate secondary treatment of nitrate (80 percent removal) and metals. The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved and the total inorganic nitrogen concentration in Libby, Ramsey, or Poorman creeks would not exceed 1 mg/L. The Order also adopted the modifications developed in Alternative 3, Option C, of the Final EIS (1992), addressing surface and ground water monitoring, fish tissue analysis, and instream biological monitoring.

Table 94. Nondegradation Limits Established by BHES Order for the Montanore Project and Montana Surface Water Quality Standards.

Parameter – Category[1]	BHES Order Nondegradation Limits (mg/L)	Human Health Standard (mg/L)	Aquatic Life Standard[2]	
			Acute (mg/L)	Chronic (mg/L)
Temperature (°F) - H	—	—	1ºF max increase for naturally occurring range of 32º to 66ºF, 67ºF max 0.5ºF max increase for naturally occurring 66.5ºF or greater 2ºF per hour max decrease for naturally occurring temperatures above 55ºF; 2ºF max decrease for naturally occurring range of 32º to 55ºF	
pH (s.u.)	—	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5
Dissolved Oxygen - T	—	—	8.0 (early life) 4.0 (other life stages)	9.5 (early life) 6.5 (other life stages)
Total dissolved solids	100	—	—	—
Turbidity (NTU) - H	—	—	No increase above ambient	No increase above ambient
Total Inorganic Nitrogen (TIN), as N – T	1	—	—	—
Nitrate + nitrite, as N – T	See TIN value	10	No excessive amounts	No excessive amounts
Ammonia, as N - T	See TIN value	—	Calculated based on stream pH	Calculated based on stream pH and temperature
Aluminum [3] – T	—	—	0.75	0.087
Antimony [3] – T	—	0.0056	—	—
Arsenic [3] – C	—	0.01	0.34	0.15
Cadmium [3] – T	—	0.005	0.00052	0.000097
Chromium [3] – T	0.005	—	0.579	0.0277
Copper [3] – T	0.003	1.3	0.00379	0.00285
Iron [3] – H	0.1	—[5]	—	1.0
Lead [3] – T	—	0.015	0.014	0.00055
Manganese [3] – H	0.05	—[5]	—	—
Mercury [3] – T	—	0.00005	0.0017	0.00091
Nickel [3] – T	—	0.1	0.145	0.0161
Selenium [3] – T	—	0.05	0.02	0.005
Silver [3] – T	—	0.1	0.00037	—
Zinc [3] – T	0.025	2	0.037	0.037

[1] T = toxic; C = carcinogen; H = harmful (aquatic life).
[2] Many metals standards are hardness dependent; for this table, values presented are based on a hardness of 25 mg/L.
[3] All metals standards, except aluminum, are based on total recoverable concentrations. Aluminum standards are based on the presence of dissolved aluminum and are valid only in pH range of 6.5 to 9.
[4] Standards are water column concentrations. Early stages include all embryonic, larval stages and all juvenile fish to 30 days following hatching. Acute concentration is instantaneous concentration to be achieved at all times; chronic concentration is 30-day mean.
[5]The concentration of iron or manganese must not reach concentrations that interfere with the uses specified in the surface and ground water standards (ARM 17.30.601 *et seq.* and 17.30.1001 *et seq.*). The Secondary Maximum Contaminant Level of 0.3 mg/L for iron and 0.05 mg/L, which are based on aesthetic properties such as taste, odor, and staining, may be considered as guidance to determine the levels that will interfere with the specified uses.
mg/L = milligrams/liter; — = No applicable standard.
Source: BHES 1992; Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2008; ARM 17.30.623.

3.12.1.1.2 MPDES Permit No. MT-0030279

A MPDES permit was originally issued to Noranda in November 1997 for Libby Adit discharge to the local ground water or Libby Creek. The permit was renewed by DEQ, effective April 1, 2006 and will expire on March 31, 2011. Three outfalls are included in the permit (Figure 15): Outfall 001 – percolation pond; Outfall 002 – infiltration system of buried pipes; and Outfall 003 – pipeline outlet to Libby Creek. A minor modification of the MPDES permit in 2008 reflected an owner/operator name change from Noranda to MMC.

3.12.1.2 Applicable Regulations and Standards

MPDES permits are required for discharges of wastewater to state surface waters. MPDES permits regulate discharges of wastewater by imposing, when applicable, technology-based effluent limits (TBELs) and state surface water quality standards, which include numeric and narrative requirements, nondegradation criteria, and Total Maximum Daily Loads (TMDLs).

3.12.1.2.1 Technology-Based Effluent Limits and Effluent Limitations Guidelines

For industrial sources, national ELGs have been developed for specific categories of industrial facilities and represent technology-based effluent limits. The Montanore Mine site is in an industrial category that is specifically identified and included in the ELGs at 40 CFR 440, Ore Mining and Dressing Point Source Category, Subpart J – Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory.

The federal ELGs apply to mine drainage and process wastewater that discharge to surface water. Mine drainage is “any water pumped, drained, or siphoned from a mine” (40 CFR 440.131). Process wastewater is “any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate produce, finished product, by-product, or waste product” (40 CFR 401.11). In terms of the ELG requirements for copper mines that use froth flotation for milling, tailings water is process wastewater. Tailings impoundment seepage would be addressed in the MPDES permit in the context of the federal ELGs. Process wastewater from copper mines that use froth flotation for milling is not allowed to be discharged to state surface waters except in areas of net precipitation.

3.12.1.2.2 State Standards

All surface water in the analysis area is classified by DEQ as either A-1 (within wilderness areas) or B-1. Water quality standards are nearly identical for A-1 and B-1 waterbodies. An A-1 classification has stricter protection requirements associated with allowable levels of impurities for drinking, culinary, and food-processing purposes, and stricter protection requirements associated with allowable levels of turbidity. The water quality of both A-1 and B-1 waterbodies must be suitable for bathing, swimming, and recreation, aquatic life, wildlife, and agricultural and industrial uses. Surface water in the wilderness is classified as A-1, where stricter allowable changes are defined to maintain the water quality classification.

Montana water quality standards for inorganic pollutants applicable to the project are provided in Table 94. The DEQ also has required reporting limits for pollutants. Some surface water quality parameters (*i.e.*, specific conductivity, hardness, total dissolved and suspended solids, carbonate, bicarbonate, chloride, and sulfate) have no numeric standards in Montana, but these parameters serve as indicators of water purity and potential human health or aquatic life impairment. Numeric nondegradation limits in surface and ground water adjacent to the Montanore Project were established by the BHES Order for certain parameters; state surface water quality standards

for these parameters are also provided in Table 94. For B-1 streams, short-term narrative standards for total suspended sediment and turbidity may be established for stream-related construction activities.

3.12.1.2.3 Nondegradation

The Montana Water Quality Act requires the DEQ to protect high quality waters from degradation. The current nondegradation rules were adopted in 1994 in response to amendments to Montana's nondegradation statute in 1993 and apply to any activity resulting from a new or increased source that may degrade a high quality water. These rules do not apply to sources, such as the Montanore Project, that received an authorization to degrade prior to the adoption of the 1993 amendments to Montana's nondegradation statute.

3.12.1.2.4 Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act requires states to assess the condition of state waters to determine where water quality is impaired (does not fully support uses identified in the stream classification or does not meet all water quality standards) or threatened (is likely to become impaired in the near future). The result of this review is the compilation of a 303(d) list, which states must submit to the EPA biannually. Section 303(d) also requires states to prioritize and target water bodies on their list for development of water quality improvement strategies (*i.e.*, Total Maximum Daily Loads or TMDLs), and to develop such strategies for impaired and threatened waters. A TMDL has not been prepared or approved by the EPA for any pollutant in the analysis area. Three streams in the analysis area are listed on the most current Montana 303(d) list. These streams are two segments of Libby Creek, the Fisher River, and Rock Creek.

Libby Creek is separated into two segments on the 303(d) list. The upper segment is from 1 mile above Howard Creek to the U.S. 2 bridge. This segment is listed as not supporting drinking water and partially supporting its fishery and aquatic life. Agricultural and industrial beneficial uses are fully supported. Contact recreation has not been assessed. Probable causes of impairment listed are alteration in stream-side or littoral vegetative covers, mercury, and physical substrate habitat alterations. Probable sources of impairment are from impacts from abandoned mine lands and placer mining.

The segment of Libby Creek from the U.S. 2 crossing to the confluence with the Kootenai River is listed as impaired for its fishery and aquatic life. Probable causes of impairment are physical substrate habitat alterations and siltation/sedimentation. Probable sources of impairment are listed as site clearance (land development or redevelopment), streambank modification/destabilization, and unknown sources. Agricultural and industrial uses are fully supporting and drinking water and contact recreation have not been assessed.

The Fisher River from the confluence of the Silver Butte Fisher River and the Pleasant Valley Fisher River to the confluence with the Kootenai River is also included on the Montana's 303(d) list, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Fisher River impairment are a high flow regime and high lead concentrations (source unknown), with probable sources of these impairments listed as channelization, grazing, road runoff, road construction, silvicultural activities, and streambank modification and destabilization.

Rock Creek from the headwaters to the mouth below Noxon Dam is also listed, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Rock Creek

impairment are other anthropogenic substrate alterations, with probable sources of these impairments listed as silvicultural activities. TMDLs are not required on Rock Creek because no pollutant-related use impairment has been identified.

3.12.2 Analysis Area and Methods

3.12.2.1 Analysis Area

The geographic scope of the analysis area includes the area where surface water quality may be affected either by mine operations or by installation and maintenance of the transmission line. This area includes the Libby Creek, Rock Creek, East Fork Bull River, Miller Creek, Fisher River, and Midas Creek watersheds (Figure 76).

3.12.2.2 Baseline Data Collection

Noranda began a project-specific surface water quality sampling program during late April 1988, and continued through March 1989 for the initial baseline monitoring period. Water quality samples were collected simultaneously with flow measurements at each station (Table 95). For the first year of baseline monitoring, samples were collected twice monthly during the spring runoff period (April through June) and monthly during non-runoff flow conditions. Water quality samples collected during the first year of baseline monitoring were analyzed for parameters presented in Table 95. Field measurements of specific conductance (SC), pH, and water temperature also were collected at each station at the time of sampling.

Table 95. Surface Water Quality Parameters Analyzed in Initial Baseline Monitoring.

Field Parameters	Common Ions	Metals[†]	Others
pH	Calcium	Aluminum	Nitrite and Nitrate as N
Specific conductance	Magnesium	Antimony	Ammonia
Temperature (ºC)	Sodium	Arsenic	Total Kjeldahl Nitrogen as N
	Potassium	Cadmium	Orthophosphate as P
	Carbonate	Chromium	Total phosphorous as P
	Bicarbonate	Copper	Total dissolved solids
	Chloride	Iron	Total suspended solids
	Sulfate	Lead	Turbidity
	Fluoride	Manganese	Hardness, as calcium carbonate
		Mercury	Alkalinity, as calcium carbonate
		Molybdenum	Oil and Grease[‡]
		Silver	
		Zinc	

[†]Samples were collected in the field and analyzed in the laboratory for total recoverable metal concentrations. Total recoverable metals were analyzed in the laboratory using procedures described in EPA 600/4-79-020.
[‡]Oil and Grease was analyzed once for each surface water site to establish baseline conditions.
Source: Geomatrix 2006d.

Subsequent to the first year of baseline monitoring, Noranda established an “interim” monitoring program to continue baseline monitoring of surface water from April 1989 through November 1997 (Chen-Northern, Inc. 1990, 1991, 1992, 1993; Huntingdon Engineering & Environmental, Inc. 1994, 1995; Maxim Technologies, Inc. 1996, 1997, 1998). MMC collected four surface water samples in October 2004 to verify Noranda’s data. During the interim monitoring period, water samples also were collected of discharge from the Libby Adit. These adit water sampling events occurred from 1993 through 1998 and in 2006 (Geomatrix 2006d).

Parameters analyzed in surface water samples collected during the interim period generally were similar to those sampled during the initial baseline monitoring period. From 1992 through 1994, four additional metals (antimony, beryllium, nickel, and thallium) were added to the analytical parameter list. Beginning in 1995, surface water samples were only analyzed for nitrate+nitrite, ammonia, SC, and pH.

Surface water samples also were collected in the East Fork Rock Creek and East Fork Bull River watersheds in 1998 to 2000 (Gurrieri 2001) and in 2005 (Geomatrix 2006a). In addition, the Northern Region of the Forest Service is conducting a long-term air quality study using high mountain lakes as barometers of change. The study began in 1992 and includes the Upper and Lower Libby Lakes. The purpose of the study is to provide a chemical record of air pollution impacts to the Libby Lakes and other northwest wilderness lakes that are sensitive to acid precipitation (Story, pers. comm. 2006). The Forest Service also collected surface water samples from Little Cherry Creek (at the LC-100 location) in 1962 through 1965, from Miller Creek in 1977 to 1982 and in West Fisher Creek from 2001 to 2006 (Wegner, pers. comm. 2006d). The KNF has been collecting surface water samples from East Fork Rock Creek and the East Fork Bull River from 1994 through 2006 (Neesvig, pers. comm. 2006).

3.12.2.3 Impact Analysis

3.12.2.3.1 Analysis Approach

A mass balance approach was used to predict potential water quality changes resulting from mine drainage wastewater discharge. Mass balance calculations were completed for three streams near where discharges would occur: Libby, Poorman, and Ramsey creeks. The mass balance calculations provide predicted concentrations, after mixing, of total dissolved solids, ammonia, nitrate, copper, iron, manganese, and zinc. Predicted concentrations of other metals were not developed because the estimated median concentrations of these metals in receiving streams (Table 96 and Table 97) and estimated average concentrations in wastewater (Table 100) were less than detection limits, but greater than water quality standards or the BHES Order limits. Thus, no conclusions could be made if mass balance analyses were completed. These metals are not discussed further.

Temperature is an important criterion for aquatic life and Montana has a surface water standard for temperature (Table 94). Stream temperatures may potentially be affected only if discharges were made directly to surface water. Temperature was not included in the mass balance calculations because the temperature of any discharge to surface water is not known. If a discharge to surface water were needed in any alternative, a MPDES permit limit for temperature would be set at a level protective of aquatic life. Temperature is not discussed further.

Streamflows used for the calculations were calculated $7Q_{10}$ flows (see next section 3.12.2.3.2, *Water Quantity*). Discharge rates used in the mass balance calculations are provided in Appendix G

Stormwater runoff events associated with storms exceeding the 10-year/24-hour storm (the design capacity of the stormwater retention ponds) were not analyzed. The water quality of both the storm runoff and the storm flows of the receiving streams are unknown. Therefore, a qualitative analysis of possible changes in stream water quality during storm runoff events was completed. Streamflows would be very high during such an event, with discharges to Poorman and Ramsey creeks likely less than 5 percent of the peak flow. Any discharges from stormwater retention ponds would be sampled and regulated.

For springs and lakes, for which changes in flows or lake levels could not be quantified, a qualitative analysis of possible changes in spring or lake water quality was completed. Limited data are available on the relative contribution of direct surface runoff, shallow ground water, and deeper bedrock ground water, and the water quality of each source to surface water at specific locations. Therefore, surface water quality changes to streams, springs, and lakes due to reduced contributions from deeper bedrock ground water were evaluated qualitatively.

Changes in surface water quality due to diversions of streamflows near the tailings impoundment also were evaluated qualitatively. Potential changes to surface water quality due to construction and maintenance of the transmission line also were evaluated qualitatively because effects would be contingent upon the effectiveness of construction and post-construction BMPs at stream crossings and along access roads located adjacent to streams.

3.12.2.3.2 Water Quantity

The DEQ's standard surface water mixing zone rules (ARM 17.30.516) require the use of the $7Q_{10}$ flow to assess effects of discharges that may affect surface water. The method used to calculate $7Q_{10}$ flow was developed by the USGS (Hortness 2006) (Appendix G). The calculated $7Q_{10}$ flows for analysis area monitoring locations were:

- 1.38 cfs for Ramsey Creek at RA-400
- 1.46 cfs for Ramsey Creek at RA-600
- 0.97 cfs for Poorman Creek at PM-1000
- 0.99 cfs for Poorman Creek at PM-1200
- 2.22 cfs for Libby Creek at LB-300
- 4.85 cfs for Libby Creek at LB-800
- 6.54 cfs for Libby Creek at LB-1000
- 7.25 cfs for Libby Creek at LB-2000

With the exception of stormwater runoff, water not used for mining and milling operations in Alternative 2 would be applied to the LAD Areas. Applied water that was not evapotranspired would percolate to ground water. Also, some seepage from the tailings impoundment not intercepted by the underdrain system would percolate to the ground water table. Below the LAD Areas, ground water mixed with applied water would migrate to adjacent streams. Below the tailings impoundment, such water would be captured by a pumpback well system before reaching surface water and returned to the tailings impoundment. Section 3.10.4.2.3, *LAD Areas* provides

the agencies' analysis of the maximum possible application rate of wastewater that could occur to the LAD Areas based on guidance documents from the Corps and EPA (U.S. Army Corps of Engineers 1982b; Environmental Protection Agency 2006b) and limitations due to the hydrologic characteristics of subsurface unconsolidated materials. The maximum application rate to the LAD Areas that the agencies estimated would be 130 gpm for Alternative 2 and 198 gpm for Alternatives 3 and 4. The application rate was used in the agencies' analysis of effects; application rate would vary and would be based on compliance with water quality standards, BHES Order limits, and MPDES permit limits. For Alternatives 3 and 4, the agencies assumed pretreatment of nitrate, with a removal rate of 90 percent. The agencies' analysis assumed nitrate concentrations in mine and adit wastewater discharges from the mine and adits would be 2.5 mg/L for Alternatives 3 and 4 instead of 25 mg/L used in Alternative 2. Concentrations of all other parameters were assumed to be the same as Alternative 2.

3.12.2.3.3 Receiving Stream Existing Water Quality

For the mass balance analyses, estimates of the existing water quality of the streams that would receive mine drainage wastewater discharges were derived from baseline surface water monitoring data collected from 1983 to 2006 (Geomatrix 2007f). A median concentration of each parameter was calculated (Table 96 and Table 97). The detection limit was used when the reported concentration was below the detection limit. Nitrate and ammonia data for LB-300 and LB-800 between January 1990 and December 1995 were not used in the analysis. Noranda started Libby Adit construction and discharges in January 1990, and nitrate and ammonia concentrations in Libby Creek may have been affected by discharges through December 1995, and were not used in the analysis. Nitrate was not measured in any sample from LB-1000; the median concentration (0.05 mg/L) between upstream station LB 800 and downstream station LB 2000 was used. Antimony was not analyzed in any sample from RA 600; the median concentration (<0.003) in other samples from Ramsey Creek was used in the analysis.

3.12.2.3.4 Wastewater Quality

The agencies used the best available information in developing estimates of wastewater quality (Table 100). In the 1990s, Noranda sampled Libby Adit inflows during and after adit construction ceased in November 1991. Samples were analyzed for temperature, pH, anions and cations, and selected metals. These data were supplemented with data collected by the DEQ in the 1990s and by MMC in 2006. Concentrations of nitrates and ammonia were based on estimates developed by MMC (Geomatrix 2007a). The best available data for tailings water are the concentrations shown in Tables 4-18 and 4-19 of the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). The data in these two tables were averaged to develop an estimate of tailings water quality. Tables 4-18 and 4-19 of the Rock Creek Project Final EIS did not report a total dissolved solid concentration. The agencies used a total dissolved solid concentration of 200 mg/L in tailings seepage developed by MMC (Geomatrix 2007a). The best available data for mine wastewater quality are samples collected by Genesis, Inc. at the Troy Mine (Genesis, Inc. 2001, 2002). The mine had been in a temporary closure phase since 1993, so the water in the tailings pond was largely derived from discharge of water from the underground mine workings during this period. Several underground sources also were sampled separately during this period. The most representative samples came from the decant pond, which received all mine water when the mine did not operate (Jepson, pers. comm. 2008). For all wastewater discharges, the agencies used dissolved metals data in developing average concentrations because discharges would be either to the LAD Areas, or the water treatment plant would have a filtration process prior to discharge.

When parameter concentrations were reported as less than the detection limit, the detection limit was used in calculating average values.

3.12.2.4 Uncertainties Associated with the Water Quality Assessment

Changes in surface and ground water quality were projected using an analytical technique known as a chemical mass balance analysis. The mass balance analysis estimates the changes in concentrations of metals and other constituents in a receiving stream when discharges from the proposed operation are added. Projected changes in ground water concentrations are calculated in a similar manner. This projection assumes complete mixing of the discharged wastewater and ambient receiving waters. Variables used in the mass balance analysis include flow rate and ambient water quality in the receiving stream, and information on the rate and water quality of the proposed discharges.

The mass balance analysis uses the estimated wastewater quality shown in Table 100 and the discharged quantities provided in MMC's water balance for Alternatives 2 and 4 and the agencies' water balance for Alternatives 3 to predict the resulting water quality after mixing with ambient water quality at low flows. For water applied to the LAD Areas, concentrations would change due to mixing with precipitation and evapotranspiration, as described in section 3.12.2.3, *Impact Analysis*. Average precipitation and evapotranspiration rates for the 6-month growing season were used. The agencies assumed that the quality of precipitation in the LAD Areas is very good, with very low metals and total dissolved solids concentrations. Average nitrogen concentrations were available for precipitation in the analysis area (National Atmospheric Deposition Program 2008; Nanus *et al.* 2003).

Projections of surface water quality involve a number of uncertainties. These include the ambient and discharge water qualities, ambient water quantities, discharge water quantities, effectiveness of mixing in the stream, the exact location where surface water would be affected, effectiveness of treatment of the various water quality parameters by land application, and the environmental effect from increased metals concentrations on aquatic life. Because of the complexity of the water quality assessment, each of these uncertainties is discussed briefly in the following sections. Although discussed under surface water, most of these uncertainties also apply to the ground water impact assessment.

3.12.2.4.1 Ambient Water and Wastewater Quality

The quality of ambient water and wastewater frequently cannot be definitively determined because reported water quality concentrations for many parameters, particularly metals, are below the analytical detection limits. Parameters with concentrations reported with a "less than" symbol (<) are those parameters with concentrations below the detection limit used for the parameter at the time of the analysis. Quantifiable concentrations of these parameters are unknown. For concentrations reported with a less than symbol, the value shown is the "detection limit" obtained by the analytical laboratory when analyzing the water sample.

The detection limit is the lowest concentration of a parameter detectable by a laboratory using a particular analytical procedure. Different parameters and different samples have had different detection limits in past analyses. For example, a laboratory analyzing surface water samples may have used an analytical method having a detection limit of 0.001 mg/L for lead and 0.0001 mg/L for cadmium. When a concentration is reported at less than the detection limit (<0.001 mg/L for lead, for example), the actual concentration is unknown. In the case of lead, the actual

concentration could be 0.0009 mg/L (just less than the detection limit), or it could be 0.000009 mg/L, (a hundred times less than the detection limit). In developing estimates of ambient water and wastewater quality, the agencies used the detection limit in calculating a median concentration when the reported concentration was below the detection limit.

Lab data reported as less than detection limits pose three difficulties for loading analyses. First, if a concentration of a metal is below the detection limit, the actual concentration is not absolutely known. If MMC's discharges have concentrations reported as less than detection limits, changes in water quality may not be detectable. Second, surface water quality standards for some parameters, such as silver, are lower than the detection limit. It is not known, and cannot be known using approved analytical methods, whether surface water quality standards for silver and some other metals are being exceeded under ambient conditions, or whether surface water quality standards would be exceeded as a result of MMC's proposed discharges having concentrations below detectable levels. Third, the use of values equivalent to the detection limit in the loading analysis may overestimate or underestimate projected concentrations. Other methods for handling below detection limit data have been proposed, but such methods are typically used on larger data sets and data sets with more consistent detection limits within the data set. MMC would use lower, more sensitive detection limits during construction, operational, and post-operational monitoring than were used in the past.

For all assessment locations, median concentrations of all samples collected at a particular location were used to represent concentrations during low flow conditions. Median concentrations may be higher or lower than actual concentrations during low flow periods. For example, concentrations of total dissolved solids may be greater during low flow periods. Projected final mixing concentrations would be greater if the ambient low flow concentration is higher than the median concentration of all the samples or lower if the ambient low flow concentration is lower.

3.12.2.4.2 Nitrate and Ammonia Concentrations

Nitrate and ammonia concentrations (reported as N [nitrogen]) of the wastewater from the mine and adits are not known. Using best professional judgment, MMC provided estimated nitrate and ammonia concentrations from blasting. For water pumped from construction adits and mine workings, the estimated nitrate concentration range is 15 to 25 mg/L and the ammonia concentration range is 5 to 10 mg/L. Data from the Libby Adit during the construction by Noranda and from the nearby Troy Mine show a wide range of nitrate and ammonia concentrations during construction. MMC anticipates, and the agencies concur, that proper management of explosives and use of emulsions would reduce nitrate concentrations from those detected during the Libby Adit construction. Additional data on nitrate and ammonia concentrations would be collected during the Libby Adit evaluation program in accordance with MMC's existing MPDES permit.

The agencies used the Libby Adit water quality data collected by Noranda after adit construction ceased and nitrate and ammonia concentrations were not affected by blasting to develop an estimate of nitrate and ammonia concentrations in wastewater from post-construction adits. The average nitrate concentration is estimated to be <0.21 mg/L and the average ammonia concentration is <0.06 mg/L in wastewater from post-construction adits.

3.12.2.4.3 Ambient Water Quantity

Surface water low-flow conditions are conservative situations for assessing impacts from pollutant discharges. For the mass balance analysis, calculated $7Q_{10}$ values were used for

assessing potential impacts to surface water quality (see section 3.12.2.3, *Impact Analysis*). Use of a $7Q_{10}$ flow is consistent with the DEQ's standard surface water mixing zone rules (ARM 17.30.516). Measured low flows (Table 84), during which maximum pollutant concentrations may occur, are lower than the calculated $7Q_{10}$. Flows lower than the $7Q_{10}$ would result in higher instream concentrations than projected, if other assumptions in the mass balance analysis remain constant.

A ground water flux beneath the two tailings impoundment sites and LAD Areas was calculated for assessing impacts to ground water. MMC's and the agencies' estimates of ground water flux are based on available data in the two tailings impoundment sites and LAD Areas. Ground water flux is discussed in sections 3.10.4.2.2, *Tailings Impoundment* and 3.10.4.2.3, *LAD Areas*. To derive ground water flux, estimates of ground water gradient and hydraulic conductivity are required. If actual conductivities or gradients were higher than estimated, lower ground water concentrations than those projected would occur.

3.12.2.4.4 Wastewater Quantity

Projected wastewater quantity is based on the estimated water balance for each alternative. MMC's and the agencies' water balances are point estimates developed using reasonable methods and assumptions. Actual flow rates for a number of water sources described by the water balance, such as mine and adit inflows, precipitation and evaporation, and dust suppression, would vary seasonally and annually from the rates shown in the estimated water balances. Actual inflows without grouting could be considerably different than those estimated. The estimates are for "steady-state" conditions, or conditions that would occur over the long term. Initial inflows would be higher than steady-state conditions because water stored in saturated fractures and faults would be initially drained. It is not possible to accurately predict actual "steady-state" adit inflows. Mine inflow estimates have the same uncertainty.

The agencies used mine and adit inflows of 1,200 gpm to assess impacts to surface and ground water quality. MMC requested the use of 1,200 gpm to assess storage and discharge requirements; such a rate likely would be a maximum inflow rate that may occur during relatively short-term dewatering of fractures (see section 3.10.3.1.2, *Conceptual Model of the Mine-Area Bedrock Hydrogeology*). Except for short-term elevated inflow rates from initial dewatering of fractures, the steady-state long-term inflow rates for the mine and adits are estimated to be 600 to 800 gpm (Geomatrix 2007c). The agencies' numerical model estimated the steady-state long-term inflow rates for the mine and adits to be 450 gpm. It is very unlikely that a inflow rate of 1,200 gpm would occur on a sustained basis throughout the project. The amount of wastewater that would be discharged to the LAD Areas is independent of the mine and adit inflow rates. The agencies' estimate of the discharge rate to the LAD Areas is discussed in section 3.10.4.2.3, *LAD Areas*.

Because of uncertainties in the operational water balance and the discharge rates, the agencies would require extensive monitoring of operational flows and discharges. This may require long-term monitoring after mine closure. If the actual discharge rates were different than currently estimated, a new mass balance analysis would be performed to determine if additional mitigations would be required.

3.12.2.4.5 Water Quality Assessment Locations

Some uncertainty is associated with how and where streams would be affected by discharges from the LAD Areas. In projecting impacts on surface water quality, the agencies chose monitoring stations on Ramsey Creek, Poorman Creek, and Libby Creek, some of which are

long-term water quality monitoring sites. A station on Libby Creek (LB-1000) was used to assess the effects of all discharges. For example, a certain percentage of the discharge water from LAD Areas 1 and 2 for Alternative 2 was assumed to flow to Ramsey Creek, Poorman Creek, or Libby Creek based on site topography; the actual rate of discharge to each stream may be different. In addition, the locations in each stream at which water from the LAD Areas would discharge may be above or below the monitoring locations used for this impacts analysis (Figure 76).

3.12.2.4.6 Land Application Treatment

Land application treatment is very site- and effluent-specific. The amount of precipitation that occurs on a land treatment site, the quality of the precipitation and the rate of evapotranspiration from the land treatment site are variable and uncertain. Many factors affect treatment effectiveness (see section 3.12.4.2.2, *Effects of Discharges*). It is not possible to estimate actual removal rates for total dissolved solids, nutrients, and metals until mine wastewater application to the LAD Areas occurs and monitoring data are collected. The percent removal values used for total dissolved solids, nitrogen, and metals are uncertain (see section 3.12.4.2.2, *Effects of Discharges*). For the analysis of the effects of land application of wastewater, it was assumed that there would be no operational issues at the LAD Areas, such as uneven application of wastewater or runoff from the site directly to streams prior to treatment. It was also assumed that the treatment rates would not change over time, which may be realistic if LAD sites are properly monitored, inspected and maintained.

3.12.2.4.7 Time

For the water quality impact analysis, it was assumed that the percolation of treated ground water from the LAD Areas would be essentially a direct discharge into the receiving stream. Depending on the effective porosity of the aquifer under the LAD Areas (which is unknown, but estimated) and the actual flow path, the water treated at the LAD Areas may take from less than a year up to 10 years to reach receiving streams (see section 3.10.4.2.3, *LAD Areas*).

3.12.2.4.8 Environmental Effects on Aquatic Life

There is some uncertainty associated with the concentrations at which metals affect aquatic life in the analysis area. Montana surface water quality standards shown in Table 94 are based on a hardness of 25 mg/L as calcium carbonate ($CaCO_3$); actual hardness in area streams ranges between about 5 and 25 mg/L. Environmental effects on aquatic life from those metals that are hardness-related (cadmium, chromium, copper, lead, nickel, and silver) may occur at concentrations less than those shown in Table 94.

3.12.3 Affected Environment

3.12.3.1 Streams

Median surface water quality during the baseline monitoring period of the mine area streams is summarized in Table 96 and Table 97. Surface waters are a calcium bicarbonate-type water. Total suspended solids, total dissolved solids, major ions, and nutrient concentrations are all low, frequently at or below analytical detection limits. Generally, total dissolved solids concentrations, major ion concentrations, and concentrations of some minor ions such as iron increase downstream in Libby Creek and its tributaries. The highest median total dissolved solids concentrations in the analysis area were found at the downstream station in Little Cherry Creek and in the East Fork Bull River.

Table 96. Median Concentrations of Various Parameters at Sampling Sites in Ramsey Creek, Poorman Creek, and Little Cherry Creek.

Parameter (mg/L unless otherwise noted; see footnote)	RA-600			PM-1000			LC-800		
	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL
Field Measurements and Physical Parameters									
Field Temperature (C)	4	24	0	6	27	0	9	14	0
Field pH (SU)	6.7	21	0	6.8	28	0	7.2	17	0
Lab SC (µmhos/cm)	14	24	0	24	29	0	59	15	0
Total dissolved solids	<13	24	1	<20	31	3	<38	17	1
Total suspended solids	<1	24	18	<1	31	28	<4	18	8
Anions and Cations									
Alkalinity, Total as $CaCO_3$	5	24	0	12	31	0	27	18	0
Alkalinity, Bicarbonate as HCO_3	6	23	0	14	30	0	30	18	0
Chloride	<1	24	19	<1	30	24	<1	16	9
Sulfate	<2	24	5	<2	30	7	<2	17	7
Calcium	<1	24	18	<3	31	1	5	18	0
Magnesium	<1	24	24	<1	31	20	<3	18	1
Potassium	<1	24	24	<1	31	29	<1	18	11
Sodium	<2	24	6	<2	31	13	<1	18	1
Hardness	<6	24	18	<9	31	7	<24	18	1

Note: Table continued on next page.

Parameter (mg/L unless otherwise noted; see footnote)	RA-600			PM-1000			LC-800		
	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL
Nutrients									
Nitrate + Nitrite, as N	<0.06	24	2	0.05	31	0	<0.02	18	10
Ammonia, as N	<0.05	24	17	<0.10	31	23	<0.05	18	8
Total Phosphorus	<0.005	24	11	<0.008	31	14	<0.010	18	6
Phosphorus - Ortho	<0.005	24	21	<0.024	31	26	<0.007	18	10
Total Recoverable Metals									
Antimony	NM	0	0	<0.003	9	9	<0.003	9	9
Arsenic	<0.005	24	24	<0.005	31	31	<0.005	18	18
Cadmium	<0.0002	24	8	<0.0001	31	16	<0.0001	18	14
Chromium	<0.02	24	24	<0.02	31	31	<0.01	18	17
Copper	<0.001	24	12	<0.001	31	18	<0.001	18	10
Iron	<0.05	24	22	<0.05	31	31	<0.08	18	5
Lead	<0.001	24	23	<0.001	31	29	<0.002	18	16
Manganese	<0.02	24	23	<0.02	31	31	<0.02	18	8
Mercury	<0.0002	24	21	<0.0002	31	28	<0.0002	18	17
Silver	<0.0002	24	21	<0.0002	31	29	<0.0002	18	15
Zinc	<0.02	24	21	<0.02	31	27	<0.02	18	15

Sampling station locations are shown on Figure 76.
Conc. = concentration.
No. Samples = number of samples analyzed for particular parameter; No. BDL = number of analyzed samples with concentrations below the detection limit; detection limit varied between sample events and parameter; detection limit used in calculating median when reported concentration was below the detection limit.
All values are in milligrams per liter (mg/L) unless noted in first column.
µmhos/cm= micromhos per centimeter; s.u. – standard units; ºC = degrees Celsius; < = less than concentration shown; NM = parameter not measured.
Source: Geomatrix 2007f.

Table 97. Median Concentrations of Various Parameters at Sampling Sites in Libby Creek.

Parameter (mg/L unless otherwise noted; see footnote)	LB-300			LB-800			LB-1000			LB-2000		
	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL
Field Measurements and Physical Parameters												
Field Temperature (C)	5	98	0	4	24	0	10	16	0	5	21	0
Field pH (SU)	6.7	85	0	6.8	23	0	7.1	15	0	6.8	19	0
Lab SC (µmhos/cm)	21	80	0	23	24	0	35	12	0	38	22	0
Total dissolved solids	<18	62	12	18	24	0	<30	12	1	26	22	0
Total suspended solids	<1	61	48	<1	24	16	<1	12	11	<1	22	13
Anions and Cations												
Alkalinity, Total as $CaCO_3$	4	62	0	9	24	0	17	12	0	19	22	0
Alkalinity, Bicarbonate as HCO_3	5	62	0	11	23	0	21	12	0	23	22	0
Chloride	<1	61	47	<1	24	22	<1	12	11	<1	22	20
Sulfate	<2	60	18	<1	24	9	<2	12	5	<2	22	8
Calcium	<2	62	7	<2	24	4	4	12	0	5	22	0
Magnesium	<1	62	42	<1	24	23	<2	12	1	<1	22	8
Potassium	<1	61	48	<1	24	23	<1	12	6	<1	22	15
Sodium	<1	62	22	<2	24	7	<1	12	4	<1	22	7
Hardness	<7	62	26	<8	24	15	18	12	0	<17	22	7

Note: Table continued on next page.

Parameter (mg/L unless otherwise noted; see footnote)	LB-300			LB-800			LB-1000			LB-2000		
	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL	Median Conc.	No. Samples	No. BDL
Nutrients												
Nitrate + Nitrite, as N	<0.12	35	2	0.04	17	0	NM	0	0	0.06	2	0
Ammonia	<0.05	35	32	<0.05	24	15	<0.05	15	12	<0.05	22	16
Total Phosphorus	<0.006	59	23	<0.005	24	10	<0.006	12	5	<0.005	22	9
Phosphorus - Ortho	<0.005	61	48	<0.005	24	18	<0.005	12	11	<0.005	22	19
Total Recoverable Metals												
Antimony	<0.003	12	12	NM	0	0	<0.004	2	2	<0.002	1	1
Arsenic	<0.005	62	62	<0.005	24	24	<0.005	12	12	<0.005	22	22
Cadmium	<0.0001	62	49	<0.0002	24	10	<0.0001	12	11	<0.0001	22	15
Chromium	<0.02	62	61	<0.02	24	24	<0.02	12	12	<0.02	22	22
Copper	<0.001	62	30	<0.001	24	13	<0.001	12	6	<0.001	22	9
Iron	<0.05	62	54	<0.05	24	16	<0.05	12	9	<0.05	22	13
Lead	<0.001	62	54	<0.001	24	22	<0.001	12	10	<0.001	22	11
Manganese	<0.02	62	60	<0.02	24	24	<0.02	12	12	<0.02	22	21
Mercury	<0.0002	62	54	<0.0002	24	22	<0.0002	12	11	<0.0002	22	19
Silver	<0.0002	62	41	<0.0002	24	23	<0.0002	12	7	<0.0002	22	16
Zinc	<0.02	62	43	<0.02	24	21	<0.02	12	8	<0.02	22	16

Sampling station locations are shown on Figure 76.
No. Samples = number of samples analyzed for particular parameter; No. BDL = number of analyzed samples with concentrations below the detection limit; detection limit varied between sample events and parameter; detection limit used in calculating median when reported concentration was below the detection limit.
All values are in milligrams per liter (mg/L) unless noted in first column.
µmhos/cm= micromhos per centimeter; s.u. – standard units; ºC = degrees Celsius; < = less than concentration shown; NM = parameter not measured.
Source: Geomatrix 2007f.

Metal concentrations are generally low. Aluminum, arsenic, chromium, manganese, mercury, and zinc concentrations were often reported as less than the detection limits. Detectable levels of iron, copper, and silver were reported at most sampling stations. Detectable metal concentrations are probably related to local geology and mineralization. Seasonal variations are present in the baseline surface water quality data. Nutrient concentrations increase during spring runoff. Total dissolved solids decrease during spring runoff and increase during low flow periods. Total suspended solids increase during spring runoff.

Analysis area streams are poorly buffered due to low alkalinities. Consequently, surface waters tend to be slightly acidic, with most pH values slightly below 7.0. This acidity has two likely natural sources: organic acids originating from surrounding coniferous forests and dissolved carbon dioxide (CO_2) in surface and ground water draining into the area streams. Median water hardness in all sampled streams within the Libby Creek drainage was less than 30 mg/L, with several sampling locations reporting median hardness values less than 10 mg/L.

The water quality of the East Fork Rock Creek is very similar to that of the Libby Creek drainage, with low specific conductance values, low suspended solids concentrations, a hardness averaging 13 mg/L, and low nutrient and metals concentrations. The East Fork Bull River is also of good quality, but is more alkaline and has slightly higher total dissolved and suspended solids concentrations, a median hardness of about 23 mg/L, and low nutrient and metals concentrations.

3.12.3.2 Lakes

Lakes located in or near the CMW have excellent water quality. Several water samples were collected from 1998 to 2000 and in 2005 from inflow and outflow from Rock Lake (Geomatrix 2006a). The Northern Region of the Forest Service is conducting a long-term air quality study using high mountain lakes as barometers of change. This includes Upper and Lower Libby Lakes, located over the ore body. Ammonia, chloride, nitrate, sulfate, phosphorus, pH, SC, acid neutralizing capacity, and several common ions were measured in these lakes between 1994 and 2004. Available water quality values for Rock Lake and Libby Lakes are provided in Table 98. An investigation of Rock Lake completed in 1999 (Gurrieri and Furniss 2004) found that during the ice-free season, ground water contributed 71 percent of the minerals to the lake, surface water contributed 25 percent, and rainfall contributed 4 percent. The Libby Lakes are extremely dilute and very vulnerable to acid deposition (Story 2006). For this reason, they have been and continue to be monitored annually.

Seasonal variations in the water quality of Rock Lake indicate that the volume of inflow from various sources (snowmelt, rainfall, shallow and deep ground water) varies proportionally during the year. Because the watershed above Rock Lake consists of highly resistant bedrock with little vegetation and soil cover, snowmelt and surface water entering the lake is very diluted.

Table 98. Average Baseline Water Quality for Analysis Area Lakes.

Sample Site	Upper Libby Lake	Lower Libby Lake	Rock Lake	St. Paul Lake
Sample dates	7/92 to 7/04	7/94 to 7/04	7/22/99 to 10/22/99	10/3/01
No. of Samples	14	13	6	1
Field Measurements and Physical Parameters				
pH (s.u.)	5.68	6.04	6.4	6.7
Specific conductance (µmhos/cm)	2.4	3.84	6.8	18.2
Anions and Cations (mg/L)				
Chloride	0.11	0.18	0.049	0.072
Sulfate	1.12	0.25	0.267	0.450
Calcium	0.09	0.18	0.671	2.387
Magnesium	0.02	0.05	0.178	0.621
Hardness as $CaCO_3$	0.72	0.3	2.4	8.5
Sodium	0.14	0.29	0.148	0.309
Potassium	0.06	0.10	0.111	0.189
Nutrients (mg/L)				
Nitrate	0.08	0.02	0.047	<0.010
Ammonia	0.02	0.03	0.02	<0.010
Orthophosphate	<0.01	<0.01	<0.01	<0.01

mg/L = milligrams per liter, µmhos/cm= micromhos per centimeter, s.u. = standard units, °C = degrees Celsius.
Source: Gurrieri and Furniss 2004; Geomatrix 2006d; Story, pers. comm. 2006.

3.12.3.3 Springs

All ground water in the analysis area is the result of infiltration of precipitation and the reported water quality indicates that percolating ground water gradually becomes more mineralized as it moves through the various geologic formations, without changing water types. This water quality transition is a good indicator of the source of ground water to a given spring. Water quality analyses were completed on samples from springs in the Little Cherry Creek watershed, the Poorman Tailings Impoundment Site, and in the CMW (Table 99, Figure 71, and Figure 72). Springs from all areas are mostly calcium bicarbonate water, but some are sodium bicarbonate water. Springs with higher total dissolved solids and metals concentrations (*e.g.*, SP-14 and SP-30) indicate longer subsurface flow paths than other springs. A spring located directly above Rock Lake (SP-1R) appears to receive mostly shallow ground water, whereas a spring below Rock Lake (SP-3R) appears to receive a combination of shallow and deeper ground water. Several of the springs sampled in 2007 in the Poorman Tailings Impoundment Site had elevated suspended sediment concentrations, indicating that the samples were not filtered; it is likely that elevated metal concentrations in these springs are associated with the sediment in the water.

Table 99. Average Baseline Water Quality for Mine Area Springs.

Sample Site	SP-1R	SP-4/4R	SP-05/3R	SP-10	SP-11	SP-12	SP-13	SP-14	SP-15	SP-21	SP-25	SP-26	SP-27	SP-28	SP-30	SP-32
Watershed	East Fork Rock Creek	East Fork Rock Creek	East Fork Rock Creek	Little Cherry Creek	Bear Creek	Little Cherry Creek	Bear Creek	Libby Creek	Little Cherry Creek	Ramsey Creek	Libby Creek	Unnamed (Poorman Impound-ment Site)	Poorman Creek	Unnamed (Poorman Impound-ment Site)	Unnamed (Poorman TI site)	East Fork Bull River
Sample dates	10/98 – 9/05	8/88 – 9/05	8/88 – 10/99	7/89	7/89	7/89	7/89	7/89	7/89	8/07	8/07	8/07	8/07	8/07	8/07	9/06
No. Samples	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Field Measurements and Physical Parameters																
Flow (gpm)	1-10	5-20	NM	NM	NM	NM	NM	NM	NM	1	5	0.5	2	4	5	-
Temperature (ºC)	5	7	9	NM	NM	13	NM	NM	5	25.3	13	13.6	12.1	14.7	24	-
pH	6.5	7.1	6.9	6.4	7.2	5.8	7.2	NM	7.1	6.43	6.89	7.74	6.95	8.29	8.29	7.7
Specific conductance (µmhos/cm)	13	21	24	91	68	42	138	226	18	88	37.9	219.2	14.9	334	315	87
Total dissolved solids	9	20	17	97	79	86	91	154	<20	84	<10	<10	49	<10	173	-
Total suspended solids	NM	NM	NM	NM	NM	NM	NM	NM	NM	47.5	<1	79.8	<1	<1	<1	-
Anions and Cations																
Alkalinity	<76	<9	13	49	39	22	68	115	7	13	8	110	7	169	160	-
Bicarbonate	<1	<11	16	60	48	27	83	140	9	<1	<1	<1	<1	<1	<1	-
Chloride	<1	<1	<1	1	<1	1	<1	1	<1	1	1.6	1.4	1	1	<1	-
Sulfate	<2	<3	2	3	2	2	2	<1	<1	<5	<5	<5	<5	<5	<5	-
Calcium	1	<2	2	10	12	6	18	30	1	6.35	1.3	29.5	1	50.6	42.3	-
Magnesium	<1	<1	<1	5	2	1	5	8	<1	2.5	0.26	9.9	0.3	13.3	13.6	-
Sodium	<0	<1	<1	1	<1	<1	<1	<1	<1	7.25	1.7	3.2	1	2.5	2.6	-
Potassium	<1	<1	<1	2	<1	2	<1	6	<1	0.84	0.4	0.735	0.6	0.9	0.6	-
Hardness	NM	<5	<7	46	38	19	66	108	<7	26	4	114	4.6	181	161	-

Note: Table continues on next page.

Sample Site	SP-1R	SP-4/4R	SP-05/3R	SP-10	SP-11	SP-12	SP-13	SP-14	SP-15	SP-21	SP-25	SP-26	SP-27	SP-28	SP-30	SP-32
Watershed	East Fork Rock Creek	East Fork Rock Creek	East Fork Rock Creek	Little Cherry Creek	Bear Creek	Little Cherry Creek	Bear Creek	Libby Creek	Little Cherry Creek	Ramsey Creek	Libby Creek	Unnamed (Poorman Impound-ment Site)	Poorman Creek	Unnamed (Poorman Impound-ment Site)	Unnamed (Poorman TI site)	East Fork Bull River
Sample dates	10/98 – 9/05	8/88 – 9/05	8/88 – 10/99	7/89	7/89	7/89	7/89	7/89	7/89	8/07	8/07	8/07	8/07	8/07	8/07	9/06
No. Samples	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Nutrients																
Nitrate + Nitrite, as N	1.01	0.03	0.18	0.01	<0.01	<0.01	<0.05	<0.01	<0.07	0.224	0.7	0.82	0.225	<1	<1	-
Ammonia	NM	NM	NM	NM	NM	NM	NM	NM	NM	0.45	<0.05	<0.05	0.34	<0.05	0.35	-
Total phosphorus	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Orthophosphate	NM	NM	NM	NM	NM	NM	NM	NM	NM	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Total Recoverable Metals																
Arsenic	NM	<0.005	NM	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	-
Cadmium	NM	<0.001	NM	<0.0009	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0001	<0.00008	0.0001	<0.00008	0.0001	<0.00008	-
Chromium	NM	<0.02	NM	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
Copper	NM	<0.02	NM	<0.017	<0.010	<0.010	<0.010	<0.010	<0.010	0.005	<0.001	0.005	0.001	<0.001	<0.001	<0.001
Iron	NM	<0.05	NM	<0.05	<0.05	0.36	<0.05	0.67	<0.05	16	<0.01	0.789	0.017	<0.01	0.086	
Lead	NM	<0.01	NM	<0.01	<0.010	<0.010	<0.010	<0.010	<0.010	0.012	<0.0005	0.005	0.003	<0.0005	0.005	<0.01
Manganese	NM	<0.02	NM	<0.02	<0.02	<0.02	<0.02	0.71	<0.02	1.22	<0.005	0.22	<0.005	<0.005	0.014	-
Mercury	NM	<0.0002	NM	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	-
Silver	NM	<0.001	NM	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-
Zinc	NM	<0.02	NM	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

All units are milligrams per liter, except where noted; µmhos/cm= micromhos per centimeter, °C = degrees Celsius, NM = not measured
Detection limit used in calculating arithmetic average when the reported concentration was below the detection limit.
Not all samples analyzed for all analytes or parameters.
Spring locations are shown on Figure 71 and Figure 72 except for SP-25, which is located near Libby Creek about 0.5 mile below LB-300.
Source: Gurrieri 2001; Geomatrix 2006a, 2006d, and 2007a.

3.12.4 Environmental Consequences

This section describes the anticipated changes in surface water quality for each alternative. This includes analysis area streams, lakes, and springs. Potential direct effects of the project are described, as are potential cumulative effects that may occur as a result of the mine and transmission line alternatives and identified reasonably foreseeable actions.

3.12.4.1 Alternative 1 – No Mine

In this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline data collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Water quality in surface waters would not change from existing conditions.

3.12.4.2 Alternative 2 – MMC Proposed Mine

Development of the Montanore Project would require construction of project facilities, such as a mill, tailings impoundment, adits, and access roads. In MMC's proposal, the mill and mine production adits would be located in upper Ramsey Creek, about 0.5 mile from the CMW boundary. An additional adit on MMC's private land in the Libby Creek drainage and a ventilation adit on MMC's private land east of Rock Lake would be used for exploration and ventilation (Figure 2). A tailings impoundment is proposed to be constructed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek are proposed to allow for discharge of excess mine water using sprinkler irrigation of water on the land surface. A portion of the waste rock resulting from adit development may be stored temporarily at LAD Area 1, and at the Libby Adit Site. Sanitary waste would be collected and shipped off-site for treatment and disposal. The total area of disturbance for Alternative 2 would be 2,582 acres.

3.12.4.2.1 Effects of Mine Inflows

Impacts to Streams

In the stream segments whose base flows would be reduced as a result of mining, water quality changes may occur. Because deeper ground water is likely to have higher total dissolved solids concentrations (generally greater than 100 mg/L) than shallow ground water or direct runoff to streams (generally less than 50 mg/L), a decrease in the deeper ground water contribution to streamflow may result in lower total dissolved solids concentrations in affected streams. Whether water quality changes in these streams would be measurable or could be separated from natural variability is unknown.

Impacts to Lakes and Springs

The Libby Lakes are located at an elevation of about 7,000 feet, perched above the ground water table. The lakes lie on a series of faults and vertically oriented bedding planes, but there are no observations, data, or numerical model results to indicate that the lakes are hydraulically connected to the deep bedrock ground water table. It is unlikely that the Libby Lakes would be affected by mining activities. Because deep bedrock ground water is a contributor to Rock Lake throughout the year (Gurrieri 2001), mining may affect the water quality of Rock Lake. Because

of subtle differences in the quality of shallow and deeper ground water, both of which are sources to Rock Lake (Gurrieri 2001), and limited baseline data for Rock Lake, it may be difficult to differentiate changes in water quality from pre-mining water quality variability. If less ground water were contributed to Rock Lake or St. Paul Lake, water in these lakes would become more dilute, with lower total dissolved solids concentrations. Reducing the source of deeper ground water could reduce the introduction of certain minerals considered to be necessary for potential populations of organisms (Gurrieri 2001, 2008). Whether water quality changes in either lake would be measurable or could be separated from natural variability is unknown, but collection and analysis of baseline, pre-mining data would provide useful information on the natural variability of the lakes. Lake monitoring is discussed in Appendix C.

Depending on the ratio between shallow and deep ground water contribution to area springs, water quality changes may be very slight and not measurable. In the case of springs that receive a large portion of their flow from deep ground water, total dissolved solids, which are the minerals dissolved in the water, may decrease as the shallow ground water accounts for a larger proportion of the total flow. The only springs whose water quality may be adversely affected by the mine, based on the agencies' numerical model, would be those located below an elevation of about 5,600 feet.

3.12.4.2.2 Effects of Discharges

Quality of Wastewater Sources

Discharges of wastewater would occur during construction, operations, and closure phases of the mine. Except for stormwater runoff, the discharges would be to ground water, which would then seep into stream channels, so erosion and sedimentation would not occur. The sources of the non-stormwater discharges would be mine and adit mine drainage water treated at the LAD Areas, mine drainage seepage from waste rock stockpiles and from the LAD Area sediment pond and, post-closure, water from the tailings impoundment treated at the LAD Areas. Stormwater discharges through the overflow pipes from the stormwater retention ponds when storms exceed the pond capacities would flow overland about 1,500 feet to surface water and may increase erosion and stream sedimentation. In addition, seepage from the unlined retention pond at the LAD Areas or excess application of water to the LAD Areas could result in increased runoff and/or the formation of new springs, which could increase erosion and stream sedimentation. For stormwater runoff, the source of water would be runoff that would be flowing either from the Ramsey Plant Site fill slope, or the LAD Area 1 Waste Rock Stockpile and the LAD Areas during events greater than the 10-year/24-hour design storm of 2.4 inches.

The average water quality of the discharge water from each of these sources is provided in Table 100. The reader is referred to section 3.12.2.4, *Uncertainties Associated with the Water Quality Assessment* regarding the uncertainties of the estimates provided in Table 100.

When mine and adit water was applied to the LAD Areas, it would mix with precipitation, and much of it would evapotranspire. The quality of the water before chemical and biological treatment within the plant root/soil matrix would change as a result of dilution by rain water, then concentration, as about 90 percent (on average) of this water would be lost to the atmosphere via evapotranspiration. Resultant nutrient and metal concentrations were calculated and used for the chemical mass balance analysis. The water would then be treated within the plant root/soil matrix.

Table 100. Average Expected Concentrations of Wastewater in Alternatives 2, 3, and 4 Used in Mass Balance Analyses.

Parameter	Source			
	Construction Adit Water	Post-Construction Adit Water	Mine Water	Tailings Water
Total dissolved solids	162	162	140	200
Nitrate/nitrite, as N	25	<0.21	25	16.1
Ammonia, as N	10	<0.06	10	7.3
Antimony	<0.003	<0.003	0.009	0.009[†]
Arsenic	<0.004	<0.004	<0.002	<0.005
Cadmium	<0.0003	<0.0003	<0.0002	<0.002
Chromium	<0.006	<0.006	<0.001	<0.001
Copper	<0.004	<0.004	0.045	0.035
Iron	<0.05	<0.05	0.03	<0.04
Lead	<0.004	<0.004	<0.002	<0.013
Manganese	<0.01	<0.01	0.044	0.54
Mercury	<0.0002	<0.0002	<0.0002	<0.001
Silver	<0.0007	<0.0007	<0.003	<0.004
Zinc	<0.03	<0.03	0.01	<0.02
Source	Geomatrix 2007f	Geomatrix 2007f	Genesis, Inc. 2000, 2001	USDA Forest Service and DEQ 2001

[†]Antimony concentrations not reported; mine water concentrations used.
Concentrations presented with a < symbol had at least one sample with a reported concentration less than the detection limit used in calculating arithmetic average values.
Detection limit used in calculating arithmetic average when reported concentration was below the detection limit.
All concentrations are in mg/L; all metal concentrations are for dissolved metals.

Land application can substantially reduce suspended sediment, nitrogen, and metal concentrations. Nitrogen removal occurs through vegetative uptake, biological reduction through nitrification/denitrification in the soil, and ammonia volatilization. The main concern associated with land application is the potential for nitrate to be transported to ground water (Environmental Protection Agency 2006b). Nitrate removal is site- and effluent-specific; removal depends on soil physiochemical properties, soil hydraulics, soil moisture, soil organic content vegetation types, slope, and temperature. Ammonia removal is by volatilization, uptake by vegetation, and adsorption by clay minerals in the soil; its removal depends on temperature, pH, soil characteristics and soil water content. Metals are removed by adsorption, precipitation, ion exchange, biogeochemical reactions, uptake by plants and microorganisms, and complexation (Environmental Protection Agency 2006b). Metal removal is site- and effluent-specific and depends on vegetation type, soil characteristics, pH, and temperature.

Due to the many variables that have not been specifically defined for the LAD Areas, specific percent removal rates for nitrate, nitrite, ammonia and metals could not be determined. The BHES Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved by LAD treatment. Removal rates for ammonia, nitrate, and nitrite cannot be determined until LAD Area final engineering plans and

design criteria are submitted and monitoring data collection has commenced. Treatment rates for nitrogen compounds appear to vary widely, ranging from 50 to 90 percent for total nitrogen (Environmental Protection Agency 2002). Maximum nitrogen removal occurs when nitrogen is applied in the ammonia or organic form rather than the nitrate form (Georgia Department of Natural Resources 2006; Environmental Protection Agency 2006b). Ammonia represents the reduced (less oxidized) form of nitrogen, while nitrate represents the oxidized form. Ammonia is expected to be present in wastewater used on the LAD Areas. Nitrates are more readily taken up by plants, while ammonia is more readily adsorbed by soils.

In the agencies' analysis, land application treatment rates were assumed to be 50 percent for nitrogen (nitrate and ammonia) and iron. For zinc and manganese, a 10 percent removal was assumed, and for copper a 90 percent removal was assumed. A report prepared for Noranda (CDM 1991) on soil attenuation in the analysis area showed high copper attenuation in the analysis area soils. Zinc may be taken up by vegetation, but does not in general sorb readily on soils. Manganese also does not sorb readily on all soil types. In the agencies' analysis, it was assumed that 90 percent of the zinc and manganese percolated to ground water.

Chemical Mass Balance Calculations

Mass balance calculations were completed for the construction, operations, and post-mining periods. Effects to springs located close to the LAD Areas (such as SP-21), assuming that shallow ground water was a source of supply to such springs, would be similar to that calculated for ground water below the LAD Areas (Appendix G).

Predicted concentrations at RA-600, PM-1200, and LB-1000 without additional treatment beyond land application are provided in Table 101. Mass balance analyses for other locations in Ramsey, Poorman, and Libby creeks are provided in Appendix G. The projected final mixing concentrations for sites in Libby, Poorman, and Ramsey creeks were compared to the BHES Order nondegradation limits, where applicable, surface water standards, or ambient concentrations where ambient concentrations were greater than surface water standards. Nitrate and ammonia concentrations were added together to evaluate compliance with the BHES Order nondegradation limit for total inorganic nitrogen (TIN).

Table 102 provides a summary of predicted water quality exceedances for Alternative 2 due to wastewater discharge at the LAD Areas. If land application of excess water would result in water quality exceedances, MMC would treat the water at the Libby Adit Water Treatment Plant prior to land application. If needed, an additional water treatment facility may be required. Water discharged from the treatment facilities to a nearby stream would be required to meet the BHES Order nondegradation limits or water quality standards for all other parameters (Table 94). Seepage from the tailings impoundment would have to be captured prior to entering the creek to avoid water quality exceedances in former Little Cherry Creek.

Table 101. Predicted Concentrations with Land Application Treatment in Ramsey Creek at RA-600, Poorman Creek at PM-1200, and Libby Creek at LB-1000, Alternative 2.

Parameter	RA-600	PM-1200	LB-1000	Surface Water Standard or BHES Order Nondegradation Limit
During Construction				
Total dissolved solids	<30	<33	<45	100
Ammonia, as N	<0.59	<0.45	<0.24	TIN=1
Nitrate, as N	**<1.42**	**<1.06**	0.52	TIN=1
Total inorganic nitrogen	**<2.01**	**<1.51**	<0.76	TIN=1
Antimony	<0.003	<0.003	<0.004	0.0056
Copper	<0.001	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.04	0.1
Manganese	<0.02	<0.02	<0.02	0.05
Zinc	<0.02	<0.02	<0.02	0.025
During Mining				
Total dissolved solids	<29	<32	<39	100
Ammonia, as N	<0.41	<0.32	<0.19	TIN=1
Nitrate, as N	<0.97	<0.73	<0.39	TIN=1
Total inorganic nitrogen	**<1.38**	**<1.05**	<0.58	TIN=1
Antimony	<0.003	<0.003	<0.004	0.0056
Copper	<0.001	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.05	0.1
Manganese	<0.02	<0.02	<0.02	0.05
Zinc	<0.02	<0.02	<0.02	0.025
During Post-Mining				
Total dissolved solids	<34	<36	<39	100
Ammonia, as N	<0.45	<0.34	<0.21	TIN=1
Nitrate, as N	<0.93	<0.70	0.40	TIN=1
Total inorganic nitrogen	**<1.38**	**<1.04**	<0.61	TIN=1
Antimony	<0.003	<0.003	<0.004	0.0056
Copper	<0.001	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.05	0.1
Manganese	**<0.07**	**<0.06**	<0.04	0.05
Zinc	<0.02	<0.02	<0.02	0.025

All concentrations are mg/L.
Predicted exceedances of BHES Order limits or surface water standards without additional treatment beyond land application are shown in **bold**.
TIN=total inorganic nitrogen.

Table 102. Water Quality Parameters that May Exceed Standards or BHES Order Nondegradation Limits due to Wastewater Discharge at the LAD Areas, Alternative 2.

Stream Monitoring Site	Construction	Mining	Post-Mining
RA-400	TIN	none	TIN, manganese
RA-600	TIN	TIN	TIN, manganese
PM-1000	none	none	none
PM-1200	TIN	TIN	TIN, manganese
LB-300	none	none	none
LB-800	none	none	none
LB-1000	none	none	none
LB-2000	none	none	none

Monitoring sites are shown in Figure 76.
Predicted exceedances based on no additional treatment beyond land application.
TIN=total inorganic nitrogen.

Post-Mining Water Quality

After the completion of mining and plugging of the adits, ground water that filled the mine void would have the potential to flow toward the East Fork Bull River drainage. Flow to the East Fork Bull River would not occur until the mine void completely filled with water and the ground water drawdown cone reached steady-state conditions, which may take about 70 years. The quality of the post-operational mine water may be equivalent to the post-operational Troy mine water quality, which is provided in Table 103. After the mine void filled, water traveling to the surface would move through about 3,000 feet or more of fractured bedrock material. Nutrient and metal concentrations in water in the mine void would decrease before reaching the surface due to dilution and sorption. The fate and transport of dissolved metals within the flooded mine void cannot be estimated without significant uncertainty, particularly considering the relatively low surface water standards. MMC intends to construct a ground water model during the mine development period to evaluate the potential for the migration of dissolved metals from the mine void to the East Fork Bull River. If the modeling indicates that surface water standards would be exceeded in the East Fork Bull River, mitigation measures would be implemented prior to completing the mine.

For adits from which water may discharge after mine closure, a water-retaining plug would be installed in competent bedrock. Design of the water-retaining plug would be determined by hydrologic and geotechnical data. Water-retaining plugs may be located deeper into the adit than a dry plug; thus, mine entries from the portal to the plug would be backfilled. Final plugging design for “wet” openings would be prepared for the agencies’ approval before cessation of operations.

The tailings would continue to consolidate and MMC would operate the seepage collection and pumpback well facilities until water quality standards, BHES Order limits, and MPDES permit limits were met without treatment. Long-term water treatment and surface and ground water quality monitoring may be required. The LAD Areas would continue to be used for water treatment; the application rate would be adjusted to meet MPDES permit effluent limits. If

necessary, additional water would be treated at the Libby Adit Water Treatment Plant or would be cycled within the tailings impoundment.

Table 103. Expected Post-Mining Water Quality.

Parameter	Average Concentration	Maximum Concentration
Total dissolved solids	140	171
pH	8.0	Min=7.6, Max=8.3
Total hardness	97	116
Sulfate	33	42
Ammonia, as N	<0.31	4.8
Nitrate/nitrite, as N	<0.63	1.5
Antimony	0.009	0.011
Arsenic	<0.002	<0.002
Cadmium	<0.0002	<0.0002
Chromium	<0.001	<0.001
Copper	0.045	0.049
Iron	<0.03	0.031
Lead	<0.002	<0.002
Manganese	0.044	0.065
Mercury	<0.0002	<0.0002
Silver	<0.003	<0.003
Zinc	0.01	0.013

All concentrations are in mg/L.
Detection limit used in calculating arithmetic average when reported concentration was below the detection limit.
Source: Genesis Inc. 2000, 2001.

3.12.4.2.3 Effects of Diversions and other Surface Disturbances

MMC's proposed measures to control runoff and sedimentation are described in section 2.4.2.5, *Fugitive Dust and Erosion* Control. Until vegetation ground cover reached predisturbance levels, erosion rates would be higher than before disturbance and may increase stream sedimentation in and downstream of the analysis area. MMC may conduct a sediment-source inventory in the watershed and stabilize, recontour and revegetate priority sediment source areas. If selected as part of the Fisheries Mitigation Plan, these measures would reduce sediment to area streams.

Except for sediment, the diversion of Little Cherry Creek would not affect the water quality of Little Cherry or Libby creeks during or after mining. The channel would be designed for the 100-year flow and be constructed of natural materials. The new channel would be constructed prior to diverting Little Cherry Creek. The constructed channel would be subject to erosion and sedimentation until vegetation stabilizes the stream banks and floodplain. The majority of sediment generated would occur during initial channel flush and subsequent high flow and rainfall events. In the event of heavy precipitation during channel construction, substantial erosion and short-term increases in sedimentation to the lower channel and Libby Creek may occur.

Channels A and B would receive water from the constructed Diversion Channel and the existing upper Little Cherry Creek watershed. They are not large enough to handle the expected flow volumes; these channels would contribute sediment to Libby Creek due to bank erosion and channel scouring. MMC would construct some bioengineered and structural features in the two channels to reduce flow velocities, and minimize erosion and sedimentation where access were possible to complete such work. MMC also would evaluate potential locations for creating wetlands in the floodplain of Libby Creek and ponds to capture and retain sediment from the two channels. After mining, runoff from the reclaimed Little Cherry Creek Tailings Impoundment would be routed toward Bear Creek. This may increase the potential for greater sedimentation in the Bear Creek channel, particularly during large runoff events. Greater sedimentation to Libby Creek within the upper 303(d)-listed segment may occur, which could cause channel aggradation, bank erosion and channel widening. One of the possible fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically road cuts and stream crossings in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. If implemented, this project would reduce the contribution of sediment from these sources to the Libby Creek watershed.

MMC's Stormwater Pollution Prevention Plan, described in Geomatrix (2007a), would be designed to minimize erosion and sedimentation from disturbed areas. The plan describes the potential sources of stormwater pollution, pollution prevention practices, sediment and erosion control measures, runoff management, inspections and reporting. BMPs would include ditches, sediment traps, and sediment retention ponds. The surface water monitoring program would include regular sampling for total suspended sediments and turbidity.

The agencies would institute a process to review and evaluate the final tailings impoundment design to ensure long-term stability, and minimize the probability of failure. Catastrophic failure of the tailings impoundment is considered a low-probability event (see section 3.9, *Geotechnical Engineering*). A failure modes effects analysis completed for the Little Cherry Creek impoundment estimated the risk of catastrophic failure as having a 0.1 to 1 percent chance of occurrence (Klohn Crippen 2005). Should such a failure occur, sediment and tailings leachate would be uncontrollably released to the environment. 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, size of the tailings impoundment at the time of failure, volume of water associated with the failure, and the initial volume and character of the sediments and the character of concurrent releases from other sources.

Under the worst-case scenario, tailings liquids containing dissolved metals and reagent residues, and large masses of sediment would flush into the Libby Creek stream channel. Some 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. Subsequent to any such failure, seasonal high flows would continue to wash most of the remaining sediment downstream. Most of the fine sediments from any such catastrophic failure would probably persist in the Libby Creek system for many years.

3.12.4.2.4 Use of Hazardous and Non-Hazardous Chemicals

MMC would use hazardous and non-hazardous materials in its operations, including reagents during milling (potassium amyl xanthate, methyl isobutyl carbinol and polyacrylamide), lubricants, fuel, and blasting agents. Material safety data sheets for the proposed reagents are presented in MMC's Plan of Operations (MMI 2005a, MMC 2008). Some spills or releases of

these materials may occur during transport and use that may result in short-term water quality degradation of area streams. The effect would depend on the response time for cleanup, the toxicity of the material spilled, the size of the spill, how much entered the creek, and how much dilution occurred within the stream. MMC would implement its Emergency Spill Response Plan in the event of any spill or release.

3.12.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate modifications and mitigating measures proposed by the agencies that would reduce water quality impacts to area streams and springs. The major change from Alternative 2 would be locating the tailings impoundment at the Poorman Tailings Impoundment Site, which would eliminate diversion of Little Cherry Creek. The agencies' analysis assumes that all of the seepage from the Poorman Tailings Impoundment Site would be controlled, such as by pumpback recovery wells, so that none of the water would reach surface water downstream of the impoundment. The total area of disturbance for Alternative 3 would be 2,011 acres.

Based on preliminary design, the Libby Plant Site would not be built with waste rock. If the plant site were not built with waste rock, runoff would be considered stormwater and ELGs would not apply for MPDES permitting. If necessary, any wastewater not used during mining would be pretreated for nitrate prior to discharge to the LAD Areas for secondary treatment. Any wastewater that cannot meet effluent limits would require treatment, either at the Libby Adit Water Treatment Plant or a similar facility, prior to discharge.

About 11,250 gallons per day of sanitary wastewater is estimated to be produced through employee use. This estimate is based on 450 employees and an expected usage rate of 25 gallons of domestic wastewater per day per employee. Sanitary wastewater would be treated, disinfected, and sent to the mill for reuse. If effluent limits could be met, treated sanitary wastewater would be discharged at the LAD Areas during the growing season.

3.12.4.3.1 Effects of Mine Inflows

Water quality impacts to streams, lakes, and springs due to decreases in deep ground water discharges to area surface water would be very similar to Alternative 2. Because the Ramsey Adits would not be constructed, Ramsey Creek and Ramsey Lake would not be affected. Three adits in the Libby Creek drainage may reduce base flow in Libby Creek slightly more than Alternative 2, so water quality effects to Libby Creek may be slightly greater than in Alternative 2. Because deeper ground water is likely to have higher total dissolved solids concentrations (generally greater than 100 mg/L) than shallow ground water or direct runoff to streams (generally less than 50 mg/L), a decrease in the deeper ground water contribution to streamflow may result in lower total dissolved solids concentrations in affected streams. Whether water quality changes in these streams would be measurable or could be separated from natural variability is unknown. Streams, lakes, and springs that may be affected by mine inflows would be extensively monitored by the agencies before construction, during construction and throughout the mining and post-mining periods.

3.12.4.3.2 Effects of Diversions and other Surface Disturbances

It is expected that the small amount of water diverted around the Poorman Tailings Impoundment Site from the small watershed above the impoundment would not measurably affect the water quality of Little Cherry or Libby creeks. The quality of the water would be expected to be very similar to the quality of Little Cherry Creek water. A diversion channel for Little Cherry Creek

would not be constructed, so disturbance associated with such a structure would not occur in Alternative 3. The disturbance area surrounding tailings impoundment would be about 300 acres less than Alternative 2 and the potential for erosion and sedimentation to streams would be less than Alternatives 2 and 4.

The effects of a catastrophic failure of the tailings impoundment would be similar to Alternative 2 (section 3.12.4.2.3, *Effects of Diversions and other Surface Disturbances*). Depending on the nature of the failure, the thickened tailings may result in slightly less sediment delivery to Libby Creek.

In Alternatives 3 and 4, MMC would initially identify existing sediment sources in Libby Creek particularly near the plant site and then off-site in Ramsey, Poorman, or upper Libby creeks. After existing sediment sources were identified, MMC would develop sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sources. This mitigation would minimize the contribution of additional sediment to the Libby Creek watershed.

The Wildlife Mitigation Plan in Alternatives 3 and 4 includes 20.3 miles of proposed access changes during the evaluation phase and up to 20.1 miles of proposed access changes prior to mill operations in the Rock Creek, Libby Creek, and Miller Creek watersheds. MMC would build and maintain gates or barriers on the roads, and complete other activities so the roads would either be removed from service, or cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. In most cases, culverts would be removed; such removals would occur in active stream channels requiring instream work, structure placement, and fill removal. In the short term, these activities would increase sedimentation in area streams. After the activities were completed, and the roads became stabilized, sediment delivery to area streams would decrease below existing levels.

3.12.4.3.3 Effects of Discharges

Water Quality of Wastewater Sources

As in Alternative 2, discharges of wastewater would occur during construction, operations, and closure phases of the mine. If effluent limits could be met, the LAD Areas and Poorman Tailings Impoundment would receive excess water not used for mine operations during construction, mining, and post-mining. The sources of wastewater would be the same as for Alternative 2 (Table 89) except that:

- The Libby Plant Site would not be a source of mine drainage from waste rock
- Waste rock would be stored temporarily until used for dam construction at a site within the Poorman impoundment uphill from the Starter Dam; the site would be lined if necessary based on the Libby Adit waste stockpile test (section 2.5.3.4, *Waste Rock Management*)

If necessary, all of the mine drainage water proposed for discharge to the LAD Areas would be pretreated. The agencies assumed nitrate removal for the pretreatment system would be 90 percent. The agencies' analysis assumed nitrate concentrations in mine and adit wastewater discharges from the mine and adits following pretreatment would be 2.5 mg/L instead of 25 mg/L used in Alternative 2. Concentrations of all other parameters were assumed to be the same as Alternative 2 (Appendix G).

Because discharges would be small and would occur as increased ground water seepage to stream channels, erosion and sedimentation would not occur. Discharges of stormwater through the overflow pipes from the stormwater retention ponds when storms exceed the pond capacities would flow overland and may increase erosion and stream sedimentation.

Chemical Mass Balance Calculations

Predicted concentrations at RA-600, PM-1200 and LB-1000 with nitrate pretreatment and land application during the construction, mining, and post-mining periods are provided in Table 104 for Alternative 3. Mass balance analyses for other locations in Ramsey, Poorman, and Libby creeks are provided in Appendix G. Effects to springs located close to the LAD Areas, assuming that shallow ground water was a source of supply to such springs, would be similar to that calculated for ground water below the LAD Areas or tailings impoundment.

Table 105 provides a summary of predicted water quality exceedances for Alternative 2 due to wastewater discharge at the LAD Areas. If land application of excess water would result in water quality exceedances, MMC would treat the water at the Libby Adit Water Treatment Plant prior to land application. If needed, an additional water treatment facility may be required. Water discharged from the treatment facilities to a nearby stream could not cause an exceedance in a BHES Order nondegradation limit or water quality standard for all parameters (Table 94). Seepage from the tailings impoundment would have to be captured prior to entering the creek to avoid water quality exceedances in former Little Cherry Creek.

Post-Mining Water Quality

Effects on water quality would be the same as Alternative 2 (section 3.12.4.2.2, *Effects of Discharges*).

3.12.4.3.4 Use of Hazardous and Non-Hazardous Chemicals

The use, management, and fate of hazardous chemicals would be the same as Alternative 2 (section 3.12.4.2.4, *Use of Hazardous and Non-Hazardous Chemicals*).

3.12.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative.

3.12.4.4.1 Effects of Mine Inflows

Impacts to streams, lakes, and springs due to decreases in deep ground water discharges to area surface water would be the same as those described in Alternative 3 for the mining and post-mining periods (section 3.12.4.3.1, *Effects of Mine Inflows*).

3.12.4.4.2 Effects of Diversions and other Surface Disturbance

A Little Cherry Creek Diversion Channel would be built and would consist of two main sections: an upper engineered channel and a constructed lower channel to Libby Creek using Channel A proposed in Alternative 2. The engineered channel would be the same as the engineered channel in Alternative 2 and would be designed for the 6-hour Probable Maximum Flood. It would flow into a constructed channel that would be designed to be geomorphologically stable and to handle the 2-year flow event. A floodplain would be constructed along the channel to allow passage of the 100-year flow.

Table 104. Predicted Concentrations with Nitrate Pretreatment and Land Application in Ramsey Creek at RA-600, Poorman Creek at PM-1200, and Libby Creek at LB-1000, Alternative 3.

Parameter	RA-600	PM-1200	LB-1000	Surface Water Standard or BHES Order Nondegradation Limit
During Construction				
Total dissolved solids	<42	<40	<44	100
Ammonia, as N	<0.95	<0.69	<0.36	TIN=1
Nitrate, as N	<0.28	<0.21	0.13	TIN=1
Total inorganic nitrogen	**<1.23**	<0.90	<0.48	TIN=1
Antimony	<0.003	<0.003	<0.004	0.0056
Copper	<0.001	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.05	0.1
Manganese	<0.02	<0.02	<0.02	0.05
Zinc	<0.02	<0.02	<0.02	0.025
During Mining				
Total dissolved solids	<40	<38	<46	100
Ammonia, as N	<0.36	<0.47	<0.24	TIN=1
Nitrate, as N	<0.15	<0.16	<0.10	TIN=1
Total inorganic nitrogen	<0.50	<0.63	<0.34	TIN=1
Antimony	<0.003	<0.003	<0.004	0.0056
Copper	<0.001	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.05	0.1
Manganese	<0.02	<0.02	<0.02	0.05
Zinc	<0.02	<0.02	<0.02	0.025
During Post-Mining				
Total dissolved solids	<48	<45	<48	100
Ammonia, as N	<0.70	<0.52	<0.27	TIN=1
Nitrate, as N	<0.20	<0.15	0.10	TIN=1
Total inorganic nitrogen	<0.91	<0.67	<0.36	TIN=1
Antimony	<0.004	<0.003	<0.004	0.0056
Copper	<0.002	<0.001	<0.001	0.003
Iron	<0.05	<0.05	<0.05	0.1
Manganese	**<0.11**	**<0.08**	<0.05	0.05
Zinc	<0.02	<0.02	<0.02	0.025

All concentrations are mg/L.
Predicted exceedances without additional treatment beyond nitrate pretreatment and land application of BHES Order limits or surface water standards are shown in **bold**.
TIN=total inorganic nitrogen.

Table 105. Water Quality Parameters that May Exceed Standards or BHES Order Nondegradation Limits due to Wastewater Discharge at the LAD Areas, Alternative 3.

Stream Monitoring Site	Construction	Mining	Post-Mining
RA-400	none	none	manganese
RA-600	TIN	none	manganese
PM-1000	none	none	none
PM-1200	none	none	manganese
LB-300	none	none	none
LB-800	none	none	none
LB-1000	none	none	none
LB-2000	none	none	none

Monitoring sites are shown in Figure 76.
Predicted exceedances based on no additional treatment beyond nitrate pretreatment and land application.
TIN=total inorganic nitrogen.

Substantial erosion and sedimentation should not occur because the new channel would be constructed prior to diverting Little Cherry Creek. The majority of sediment generated would occur during initial channel flush and subsequent high flow and runoff events. In the event of heavy precipitation during construction of the channel, substantial erosion and short-term increases in sedimentation to the lower channel and Libby Creek may occur. Natural and biodegradable materials and vegetation would be used along stream banks and on the floodplain to minimize erosion, stabilize the stream channel and floodplain, and minimize sedimentation to the lower channel and Libby Creek. MMC would construct bioengineered and structural features in the two channels to reduce flow velocities, and minimize erosion and sedimentation, where access were possible to complete such work. Long-term monitoring and maintenance would be required, if necessary, until the agencies determine that the channel was stabilized. Even with these mitigation measures, the constructed natural-designed channel would be subject to erosion and sedimentation during construction and until vegetation stabilizes the stream banks and floodplain.

Following reclamation of the impoundment, the constructed channel would undergo an additional period of channel adjustment when runoff from the impoundment surface was directed to the Diversion Channel. The increase in flow would be about 50 percent higher than during operations, and would lead to new channel adjustments. This would likely cause short-term increases in sedimentation in the lower channel and possibly Libby Creek.

The effects of a catastrophic failure of the tailings impoundment would be the same as Alternative 2 (section 3.12.4.2.3, *Effects of Diversions and other Surface Disturbances*).

The effects of proposed fisheries and wildlife mitigation would be the same as Alternative 3 (section 3.12.4.3.2, *Effects of Diversions and other Surface Disturbances*).

3.12.4.4.3 Effects of Discharges

As in Alternative 2, discharges of wastewater would occur during construction, operations, and closure phases of the mine. The sources and quality of water would be the same as for Alternative 2. Predicted concentrations in area streams are nearly identical to those shown for Alternative 3 in Table 104 and Table 105. If necessary, MMC would treat the water at the Libby Adit Water

Treatment Plant prior to land application. If needed, an additional water treatment facility may be required. Seepage from the tailings impoundment would be captured prior to reaching surface water.

Post-Mining Water Quality

Effects on water quality would be the same as Alternative 2 (section 3.12.4.2.2, *Effects of Discharges*).

3.12.4.4.4 Use of Hazardous Chemicals

The use, management, and fate of hazardous chemicals would be the same as Alternative 2 (section 3.12.4.2.4, *Use of Hazardous and Non-Hazardous Chemicals*).

3.12.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Possible impacts to streams due to construction, operation, and maintenance of a new transmission line would not occur.

3.12.4.6 Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)

The Ramsey Plant Site's electrical service would be provided via a new, overhead transmission line. MMC's proposed alignment would be in the Fisher River, Miller Creek, Midas Creek, Libby Creek, and Ramsey Creek watersheds. This alternative would create the greatest amount of disturbance close to streams because it would have the highest new road mileage and disturbed acreage in areas with severe erosion risk, high sediment delivery to nearby streams and greatest slope failure potential (see Table 134 in section 3.18, *Soils and Reclamation*). Possible sediment sources would include new road construction, existing road upgrades, timber and vegetation clearing, soil stripping, and structure installation. The highest risk of increased sediment would occur during the construction phase of the transmission line, when trees, vegetation, and soils were removed from the transmission line corridor, substation site, and access roads.

Occasional short-term increases in the amount of sediment in analysis area streams would be likely within all watersheds. Alternative B would have the greatest effect within the watersheds of 303(d)-listed streams (Table 106) and Class 1 streams (Table 107). Alternative B would parallel about 4.7 miles of line in the Fisher River, where soils with severe erosion risk and high sediment delivery are found. Two structures and a new road would be required immediately adjacent to the river near the Fisher River crossing. Clearing for the transmission line would disturb about 83.5 acres in the watershed, and new or upgraded roads would disturb 1.9 acres (Table 106). Alternative B line clearing also would disturb 11.2 acres and 1.6 acres by new or upgraded roads in the Libby Creek drainage. The soils at the Libby Creek crossing have severe erosion risk and high sediment delivery. These two stream segments are 303(d)-listed streams. Use of BMPs, Environmental Specifications, and other design criteria would minimize sediment increases in analysis area streams under most conditions.

Table 106. Transmission Line Disturbances in the Watersheds of 303(d)-Listed Streams.

Criteria	Alternative B–North Miller Creek (ac.)	Alternative C–Modified North Miller Creek (ac.)	Alternative D–Miller Creek (ac.)	Alternative E–West Fisher Creek (ac.)
Fisher River Watershed				
Clearing area†	83.5	58.3	58.3	19.6
New roads + closed roads with high upgrade requirements	1.9	0.3	0.3	0.0
Libby Creek Watershed				
Clearing area†	11.2	9.2	9.5	9.5
New roads + closed roads with high upgrade requirements	1.6	0.3	0.3	0.3

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative E that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.
Source: GIS analysis by ERO Resources Corp. using DEQ data.

Table 107. Transmission Line Disturbances in the Watersheds of Class 1 Streams.

Feature	Alternative B–North Miller Creek (ac.)	Alternative C–Modified North Miller Creek (ac.)	Alternative D–Miller Creek (ac.)	Alternative E–West Fisher Creek (ac.)
New/High Upgrade Roads	7	<1	<1	<1
Vegetation Clearing (other than for roads)	107	72	47	47

No Class 2 streams are in the transmission line analysis area.
Source: GIS analysis by ERO Resources Corp. using FWP data.

MMC would develop and implement a construction Stormwater Pollution Prevention Plan (SWPPP) to minimize the discharge of pollutants to streams during construction. The SWPPP requires the plan to be designed for a 10-year/24-hour storm event (2.4 inches). If a larger storm occurred during the construction or reclamation period, erosion and runoff measures in the plan may not be adequate to prevent sediment from entering area streams. Pollutants may include sediment in runoff from construction sites, deposition directly into stream channels or airborne movement of dust into streams. Structural and non-structural BMPs (Appendix D) would be implemented to minimize stream pollution. After construction was completed, disturbed areas would be stabilized and revegetated. Erosion and sediment increases would decrease after vegetative cover was re-established. The DEQ would require on-site inspections of stream crossings to determine the method that would result in minimizing impacts to stream banks and water quality considering the nature and cost of the available crossing methods.

3.12.4.7 Alternative C – North Miller Creek Transmission Line Alternative

The primary modification to MMC's proposed North Miller Creek Alternative would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification would partially address issues associated with water quality by crossing less area with soils that are highly erosive and subject to high sediment delivery and slope failure (see Table 134 in section 3.18, *Soils and Reclamation*) and locating the line farther from streams and wetlands. Other modifications to the alignment are relatively small shifts along Miller Creek and an unnamed tributary to Miller Creek that would move the line farther from these streams and reduce the likelihood of sediment entering the streams. H-frame structures, which generally allow for longer spans and fewer structures and access roads, would be used on this alternative. In some locations, a helicopter would be used to place the structures. These two modifications would reduce potential impacts to water quality by reducing clearing and disturbance associated with new access roads. For analysis purposes, Alternative C would end at the Libby Plant Site proposed in Alternatives 3 and 4. Effects would be slightly greater than discussed below if this alternative were selected with Alternative 2.

New road mileage and disturbed acreage would be less in Alternative C than Alternative B (Table 33 in Chapter 2; Table 134). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be substantially less than in Alternative B.

Alternative C would have fewer disturbances in the watersheds of 303(d)-listed streams than Alternative B (Table 106). Clearing for the transmission line would disturb 58 acres in the Fisher River watershed and 9 acres in the Libby Creek watershed. New or upgraded roads would disturb 0.3 acre in both watersheds.

In Alternatives C, D, and E, installation of culverts, bridges, or other structures at stream crossings would be specified by the agencies following on-site inspections with DEQ, FS, FWP, and local conservation districts. Installation of culverts or other structures in a water of the United States would be in accordance with the U.S. Army Corps of Engineers 404 and DEQ 318 permit conditions. All culverts would be sized according to Revised Hydraulic Guide KNF (1990) and amendments. Where new culverts were installed, they would be installed so water velocities or positioning of culverts would not impair fish passage. Stream crossing structures would be able to pass the 100-year flow event.

In Alternatives C, D, and E, MMC would initially identify existing sediment sources in Libby Creek particularly near the plant site and then off-site in Ramsey, Poorman, or upper Libby creeks. After existing sediment sources were identified, MMC would develop sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sources. This mitigation would reduce the contribution of additional sediment to below existing levels in the Libby Creek watershed. Other effects of Alternative C would be the same as Alternative B (section 3.12.4.6, *Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)*).

3.12.4.8 Alternative D – Miller Creek Transmission Line Alternative

Like the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. East of the Fisher River, this alignment would cross less area with

soils that are highly erosive and subject to high sediment delivery and slope failure, reducing the potential for increased sediments in nearby streams (Table 134). Other modifications to the alignment are relatively small shifts along Miller Creek. H-frame structures, which generally allow for longer spans and fewer structures and access roads, would be used on this alternative. These two modifications would reduce potential impacts to water quality by reducing clearing associated with new access roads. For analysis purposes, Alternative C would end at the Libby Plant Site proposed in Alternatives 3 and 4. Effects would be slightly greater than discussed below if this alternative were selected with Alternative 2.

New road mileage and disturbed acreage would be less in Alternative D than Alternative B, but would be greater than Alternative C (Table 134). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be substantially less than in Alternative B. Effects of Alternative D in the watersheds of 303(d)-listed streams would be similar to Alternative C (Table 106). The agencies' mitigation would reduce the contribution of additional sediment to below existing levels in the Libby Creek watershed. Other effects of Alternative D would be the same as Alternative B (section 3.12.4.6, *Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)*).

3.12.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

This alternative alignment would end at the Alternative 3 Libby Plant Site. Like the Modified North Miller Creek Alternative, this alternative modifies the North Miller Creek Alternative by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This route would cross and slope failure, reducing the potential for increased sediments in nearby streams. H-frame structures, which generally allow for longer spans and fewer structures and access roads, would be used on this alternative in most locations. In some locations, a helicopter would be used to place the structures. These two modifications would reduce potential impacts to water quality by reducing clearing associated with new access roads. For analysis purposes, Alternative E would end at the Libby Plant Site proposed in Alternatives C and D. Effects would be slightly greater than discussed below if this alternative were selected with Alternative B.

New road mileage and disturbed acreage would be less in Alternative E than Alternative B (Table 134). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be substantially less than in Alternative B. Alternative E would have the least total disturbance in 303(d)-listed watersheds, disturbing 19.6 acres of line clearing in the Fisher River watershed, and 9.5 acres of line clearing and 0.3 acre for new or upgraded roads in the Libby Creek watershed (Table 106). The agencies' mitigation would reduce the contribution of additional sediment to below existing levels in the Libby Creek watershed. Other effects of Alternative E would be the same as Alternative B (section 3.12.4.6, *Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)*).

3.12.4.10 Cumulative Effects

Past and current actions, particularly timber harvest, road construction, and mining, have altered surface water quality in the area by increasing sedimentation, destabilizing stream channels and removing streamside vegetation. The DEQ's 303(d) listing indicates Libby Creek is impaired because of alteration in stream-side or littoral vegetative covers, mercury exceedances, and physical substrate habitat alterations likely resulting from impacts from abandoned mine lands and placer mining. Past activities also have impaired water quality in segments of the Fisher

River and Rock Creek. Current actions, such as the Snowshoe Mine and Snowshoe Creek CERCLA Project, are designed to reduce effects of past mining activities.

Suction dredging activities are currently permitted in the Libby Creek drainage. These mining activities may alter surface water quality in the area by increasing sedimentation and destabilizing stream channels. Lifting and sorting of streambeds can also mobilize elements, such as mercury and other metals. Monitoring by the KNF indicates limited sediment increases in the stream below dredging operations. At low flows, pools tend to accumulate sediment transported as bedload. Deposition of bedload would be more pronounced near the dredging sites. Unless substantial bank erosion occurs, increased sediment transport is limited because the overall sediment load delivered to the channel remains the same, and the effects downstream are probably minor (KNF 2007c). Other human activities that may impair surface water quality include septic field installation, livestock grazing, new roads, and other construction. Stream channel and bank stabilization or restoration projects may improve stream water quality.

The Miller-West Fisher Vegetation Management Project consists of commercial timber harvest, precommercial thinning and prescribed fire; access management changes; trail construction and improvement; treatment of fuels in campgrounds; and watershed rehabilitation activities in the Miller, Silver Butte, and West Fisher Creek watersheds. If timber harvest activities occurred during the transmission line construction, the two projects would cumulatively increase sediment in Miller Creek or West Fisher Creek, depending on the transmission line alignment. Road and access management, and watershed condition improvements proposed in the Miller-West Fisher Vegetation Management Project would minimize adverse cumulative effects on surface water quality.

3.12.4.11 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the KFP and the Montana Water Quality Act because alternatives would implement and maintain recommended BMPs and would comply with DEQ permitting requirements and water quality standards.

3.12.4.12 Irreversible and Irretrievable Commitments

Because discharges would be required to meet BHES Order nondegradation limits or water quality standards, the effects of the discharges to surface water quality would not be an irretrievable or irreversible commitment of surface water resources.

Water quality impacts resulting from mine inflows during and post-mining, if measurable, would be permanent and are both irreversible and irretrievable commitments of surface water resources. Under all alternatives, water quality impacts to springs located under the alternative tailings impoundment sites would be an irreversible and irretrievable commitment of surface water resources.

3.12.4.13 Short-Term Uses and Long-Term Productivity

Any change in stream water quality due to discharging mine water to area streams would be a short-term use of the resource. Changes that may occur that would affect the long-term productivity of surface water resources in terms of water quality include:

- Water quality changes that may occur due to loss of deep ground water supply to streams, springs, and lakes
- Water quality changes to streams that would occur in Alternative 2 or 4 due to the diversion of Little Cherry Creek flows into other channels

3.12.4.14 Unavoidable Adverse Environmental Effects

Sediment loading to the analysis area streams would increase due to erosion from mine facility and transmission line construction.

3.13 Water Rights

3.13.1 Regulatory Framework

The Montana Water Use Act requires that any person, agency, or governmental entity intending to acquire new or additional water rights or change an existing water right in the state obtain a beneficial water use permit before commencing to construct new or additional diversion, withdrawal, impoundment, or distribution works for appropriation of ground water over 35 gpm or 10 acre-feet per year for any surface water. The Montana Water Rights Bureau, within the Water Resources Division of the DNRC, administers the Water Use Act and assists the Water Court with the adjudication of water rights.

An Application for Beneficial Water Use Permit requires proof that there is water physically and legally available at the proposed point of diversion in the amount requested (DNRC 2008). If senior water users would be adversely affected by a new use, the application must include specific conditions that the new water user is willing to accept to eliminate or mitigate potential adverse effects to senior water rights holders. For example, a new water user may need to divert or pump water only at certain times when adequate water is available for all users or may need to find water from another source to replace water taken by the new user.

Additional requirements for obtaining a new water rights permit come from the Forest Service/State of Montana Reserved Water Rights Compact (85-20-1401, MCA):

- A federal authorization is required to occupy, use, or traverse National Forest System lands for the purpose of diversion, impoundment, storage, transportation, withdrawal, use, or distribution of water for the appropriation or change of appropriation
- When a state permit is required prior to a new appropriation of water, including ground water, or a change of appropriation, the applicant is required to show proof of federal authorization before the application for a new appropriation of water or a change of appropriation will be considered correct and complete
- A state permit for a new appropriation will be subject to any terms, conditions, and limitations related to the use of water contained in the required federal authorization

3.13.2 Analysis Area and Methods

The analysis area includes the area where surface water rights may be affected by mine operations. Construction and maintenance of the transmission line would not affect surface water rights. This area includes the Ramsey Creek, Poorman Creek, Bear Creek, Libby Creek, East Fork Rock Creek, and East Fork Bull River watersheds (Figure 76). Water rights in streams in the transmission line corridors would not be affected. The impact to water rights from pumping from the make-up wells were estimated using a Theis drawdown analysis, which assumes homogeneous ground water conditions (ERO Resources Corp. 2008a). Possible impacts to surface water rights due to changes in streamflow were evaluated quantitatively by comparing pumping rates to estimated average and $7Q_{10}$ streamflows.

3.13.3 Affected Environment

Surface water in the analysis area is used for a variety of beneficial uses including domestic water supply, irrigation, mining, stock watering, fish habitat, and wildlife. The DNRC has 64 water rights on record for surface water within the Libby Creek watershed, including the use of springs and diversions along Bear, Little Cherry, Poorman, Ramsey and Libby creeks. Of these 64 rights, 19 are in the analysis area. Most of the recorded surface water permits are for domestic, irrigation, and mining or industrial use. MMC holds three water rights for mining, two for surface water (with a total diversion right for 59.9 gpm), and one for ground water (40 gpm). All but two of the 277 ground water rights are downstream of the analysis area. No surface water rights are on the East Fork Bull River and no ground water rights in the East Fork Bull River basin. One domestic surface water right for 10 gpm and a shallow ground water right for 20 gpm are held on Rock Creek about 2 miles downstream of the confluence of West Fork Rock Creek and East Fork Rock Creek.

3.13.4 Environmental Consequences

3.13.4.1 Alternative 1 – No Mine

In this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. Surface and ground water rights in the area would not be affected. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.13.4.2 Alternative 2 – MMC Proposed Mine

For all of the action alternatives, MMC would need to acquire a new ground water appropriation from the DNRC to use adit and mine inflows for mining purposes. MMC anticipates inflows to be between 600 and 800 gpm on a steady-state basis, with short-term inflows of up to 1,200 gpm.

Additional water rights for make-up water beyond the 99.9 gpm that MMC currently holds would be needed if inflows were less than about 1,000 gpm. MMC anticipates needing 144 gpm of water if mine inflows were 800 gpm and 494 gpm if mine inflows were 450 gpm. Although MMC did not specify where make-up water would be procured, it is likely that pumping from any well field would reduce flows within Libby Creek. Three Libby Creek surface water rights for mining located in Section 18, Township 28 North, Range 30 West within 1 mile of the northeast permit area boundary, downstream of the confluence of Bear Creek and Libby Creek (76D-76911-00, 76D-30480-00, and 76D-64963-00) with total rights for 800 gpm (1.8 cfs) of surface water flow in Libby Creek, would not be affected by the flow reductions even during very low flows. If mine inflows were 450 gpm, then the make-up well requirement would be about 15 percent of the estimated $7Q_{10}$ flow of Libby Creek at LB-2000. If mine inflows were 800 gpm, the make-up well requirement would be about 4 percent of the $7Q_{10}$ flow of Libby Creek at LB-800. Even during a 15 percent flow reduction, more than adequate flow in Libby Creek would be available to supply the needs of the existing water rights.

Pumping of the make-up wells would likely decrease ground water levels. A reduction in the water level elevation would not affect a spring water right for mining (76D-28349-00) for 15 gpm

located west of Libby Creek and north of Bear Creek (Section 18, Township 28 North, Range 30 West) because all of the water would be withdrawn from the Libby Creek alluvium. Before a new appropriation would be permitted by the DNRC, MMC would need to prove the physical and legal availability of the water needed at the chosen location and would need to include specific conditions that they would be willing to accept to eliminate or mitigate any potential adverse effect to senior water right holders.

Under this alternative, streamflow increases that would occur during discharges of wastewater would not adversely affect area surface or ground water rights. Reductions in streamflows and the ground water table as a result of mine inflows may affect nearby surface and ground water rights within the modeled radius of influence (see section 3.10.4.2.1, *Mine Area* for further discussion). At the locations of the existing water rights, it may be difficult to measure the effect or to separate the effect from natural streamflow variability and ground water levels.

3.13.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Under this alternative, effects to area surface and ground water rights due to mine inflows and mine discharges would be very similar to Alternative 2 (section 3.13.4.2, *Alternative 2 – MMC Proposed Mine*). If necessary, one or more bulkheads would be installed in the mine to minimize post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. Because more water would be available for mill use by thickening the tailings, less make-up water would be needed in Alternative 3. Pumping from the make-up wells would not affect existing water uses.

3.13.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The effects to area surface and ground water rights would be the same as described in Alternative 3 above.

3.13.4.5 Transmission Line Alternatives

Alternative A would not affect any water rights. The small flow changes expected to occur as a result of land clearing, dust control or concrete mixing for the transmission line alternatives are not expected to adversely affect area water rights users.

3.13.4.6 Cumulative Effects

Cumulative effects in the analysis area that could affect surface and ground water rights have been discussed in sections 3.10.4.5 and 3.11.4.10, *Cumulative Effects*. Activities could either increase or decrease water sources to streams, springs, lakes, and ground water aquifers and may affect the water supply for existing water rights if streamflows or ground water levels are reduced more than occurs due to natural variability. Modeling of the cumulative effects of mine inflows to both the Montanore and Rock Creek mines shows an increased area of ground water drawdown west of the mountain divide; a shallow ground water right on Rock Creek may be affected by the cumulative streamflow reduction that would occur in Rock Creek.

3.13.4.7 Regulatory/Forest Plan Consistency

With acquisition of water rights for mine inflows and any make-up water, all action alternatives would comply with the Montana Water Use Act and the KFP.

3.13.4.8 Irreversible and Irretrievable Commitments

This section is not applicable to water rights.

3.13.4.9 Short-Term Uses and Long-Term Productivity

This section is not applicable to water rights.

3.13.4.10 Unavoidable Adverse Environmental Effects

The issuance of a new water right would not adversely affect other water right holders.

3.14 Land Use

3.14.1 Regulatory Framework

3.14.1.1 Kootenai Forest Plan

The KFP guides all natural resource management activities and establishes management standards for the KNF (USDA Forest Service 1987). The KFP 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 it may be established for only a part of the forest plan area, a Management Area (MA). The Montanore Project is being evaluated under the 1987 KFP. The KNF is undergoing a forest plan revision in cooperation with the Idaho Panhandle National Forest. The revision is not completed and the direction provided by the 1987 KFP is applicable to the Montanore Project. Management direction for the land use analysis area is described in section 3.14.3.2, *Kootenai National Forest Land Management Plan* below.

3.14.1.2 Montana Fish, Wildlife, and Parks/Plum Creek Conservation Easement

The FWP holds a conservation easement on some lands owned by Plum Creek where the transmission line may be located. Under the terms of the conservation easement, the FWP has reserved the right to prevent any inconsistent activity on or use of the land by Plum Creek or other owners and to require the restoration of any areas or features of the land damaged by such activity or use. Activities and uses prohibited or restricted include installing any natural gas or other pipelines or power transmission lines greater than 25-kV unless the prior written approval is given by the FWP.

3.14.1.3 Local Plans

Unincorporated Lincoln County has no comprehensive or general plan, zoning regulations, or growth policies.

3.14.2 Analysis Area and Methods

3.14.2.1 Analysis Area

The analysis area for land use encompasses an area potentially affected by project facilities: along the Bear Creek Road south from U.S. 2, the proposed permit boundary areas for the mining facilities, and the area crossed by the four transmission line alternatives and associated access roads (Figure 77). MMC's mine permit application (MMI 2005a) contained information about land use in the mine area. In 2005, MMC completed a land use inventory for the transmission line corridors that MMC analyzed by reviewing, refining, and updating existing data (Power Engineers 2005c). The KNF provided digital data on the distribution of MAs on National Forest System lands. The KFP provided management prescriptions for each MA by resource, including recreation, wildlife and fish, timber, soils, water, and air resources, minerals and geology, lands, and facilities (USDA Forest Service 1987).

3.14.2.2 Methods

The effects analysis assessed how the transmission line and mine facilities may alter existing land uses on both private and public lands within the land use analysis area. The changes in land use in the mine area were calculated based on the acreage of each permit area, and a 100-foot wide road corridor along the Bear Creek Road (NFS road #278), which is outside of a permit area.

In the 1993 ROD approving the lead agencies' preferred alternative for Noranda's proposed Montanore Project, the KNF amended the KFP and reallocated an area surrounding the Little Cherry Creek Impoundment Site and the Ramsey Plant Site to MA 31. MA 31 is designed to accommodate the activities associated with mineral development on the KNF (USDA Forest Service 1993). Because of improved mapping capabilities between 1993 and 2007 and a slight change in impoundment design from that approved in 1993, all areas currently proposed for disturbance at the Ramsey Plant Site and the Little Cherry Creek Impoundment Site were not previously reallocated to MA 31. In Alternatives 2, 3 and 4, the KNF would amend the KFP by reallocating to MA 31 all areas within the permit areas of the plant site, the tailings impoundment, and LAD Areas 1 and 2 that currently are not MA 31. In addition, a proposed road and facility corridor that would cross MA 13 would need to be reallocated to MA 31. This amendment would apply only to National Forest System lands disturbed by any mine alternative, and would not apply to private lands affected by the mine alternatives. Maps showing areas of proposed reallocation are available at the KNF. Changes to existing MA designations were calculated for project facilities in each of the alternatives.

The changes in land use in the transmission line corridors were calculated based on the acreage within a 150-foot tree clearing width for monopoles (Alternative B) and a 200-foot width for H-frame structures (for other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less and would depend on tree height, slope, and line clearance above the ground. Acreage of new roads and roads with extensive upgrading requirements was based on an assumed total disturbance width of 25 feet. Miles of different management areas crossed by each alternative also were calculated.

Similar to the mine area, the KNF amended the KFP in the 1993 ROD and reallocated areas crossed by the selected North Miller Creek transmission line classified as "corridor avoidance" areas (224 acres) to MA 23. MA 23 is designed to accommodate the activities associated with electrical transmission corridors on the KNF (USDA Forest Service 1987). Because of improved mapping capabilities between 1993 and 2007 and changes in the transmission line alignment from that approved in 1993, all areas currently proposed for disturbance by MMC's proposed transmission line alignment classified as corridor avoidance areas were not reallocated to MA 23.

In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by reallocating certain areas within a 500-foot corridor of the selected 230-kV transmission line on National Forest System lands as MA 23. A corridor wider than that used in 1993 was used because the final transmission line alignment may be within 250 feet of the centerline analyzed in the EIS and within 250 feet of the approved facility location (centerline) (ARM 17.20.301 (21)). Specifically, the amendment would apply to the following MAs if crossed by the transmission line: MA 10 and 11 if the proposed corridor were within grizzly bear management situation 1 or 2; and MAs 2, 6, 12, 13, and 14. This amendment would apply only to certain National Forest System lands that currently are not MA 23 disturbed by any transmission line alternative, and would not apply to

private lands crossed by the transmission line alternatives. Maps showing areas of proposed reallocation are available at the KNF.

3.14.3 Affected Environment

The KNF manages most lands in the land use analysis area (Figure 77). Private land occurs along Libby Creek, Little Cherry Creek, Miller Creek, West Fisher Creek, and Fisher River. Mine facilities associated with the Montanore Project would be developed on patented mining claims and on unpatented mining claims on National Forest System lands under KNF's management. The KNF manages public land for multiple use benefits, including wood products, recreation, range, wildlife, mineral development, and wilderness. Forest industry land is primarily managed for wood products, and private lands are managed to satisfy individual landowner objectives. Plum Creek owns most of private lands in the land use analysis area (Figure 77).

The National Forest System lands of the Libby Ranger District provide about 6 to 8 million board feet (mmbf) of timber annually. No KNF timber sales are currently under contract in the land use analysis area as of May 2008. As discussed in section 3.3, *Reasonably Foreseeable Future Actions*, the KNF is currently considering the Miller-West Fisher Vegetation Management Project in the land use analysis area. Timber harvest activity also occurs on private, forest-industry lands. The amount of timber harvested has declined in the past 10 years. Small-scale timber harvests occur in the range of 2 to 6 mmbf annually on the private lands in the land use analysis area (Edwards, pers. comm. 2005). Plum Creek has harvested several tracts of private, forest-industry lands on lower Miller Creek and along the Fisher River.

One parcel of state land is crossed by the West Fisher Creek alignment. The DNRC manages the surface and mineral resources for the benefit of the common schools and six administrative land offices, under the direction of the State Board of Land Commissioners. The DNRC's obligation for management and administration of Trust Land is to obtain the greatest benefit for the beneficiaries. The greatest monetary return must be weighed against the long-term productivity of the land to ensure continued future returns to the trusts. The Northwestern Land Office of the DNRC facilitates local management of the state lands within the land use analysis area. Hunting also occurs on state land (Power Engineers 2005c).

Some mineral activity currently occurs in the land use analysis area, including small placer operations on Libby and Big Cherry creeks, and small lode mining operations along Libby Creek. A number of mineral operators do some form of mine development work along the east face of the Cabinet Mountains each year. The DEQ permitted three small sand and gravel operations within the land use analysis area.

One electrical transmission line is located in the land use analysis area. The BPA currently operates the Noxon-Libby 230-kV transmission line near the proposed Sedlak Park Substation. No pipelines 8 inches or greater in diameter occur within 1 mile of the transmission line alternatives.

Four Montana Department of Agriculture registered general (commercial) apiaries are located in the land use analysis area. Commercial apiaries are used for honey production and/or pollination. General (commercial) apiary registrations are apiaries placed by permission on someone's property and contain more than five hives.

3.14.3.1 Private Lands

Southern Lincoln County is a rural area with no major population centers. Large-lot residential properties, ranches, and cabins are found along U.S. 2 near Libby Creek Road (NFS road # 231), Bear Creek Road (NFS road # 278), the Fisher River, Pleasant Valley, and Schrieber Lake. The City of Libby is along the Kootenai River about 15 miles north of the land use analysis area. Fourteen residences are within 1 mile of the four transmission line alternatives. Most of these properties are within 0.5 mile of U.S. 2 (Figure 78). No platted subdivisions are within 1 mile of the transmission line alternatives. The Libby Adit Site and portions of the Little Cherry Creek Impoundment Site are private lands owned by MMC.

In 2003, Plum Creek initiated a transaction to sell a conservation easement to the FWP on 142,000 acres in northwest Montana, some of it within the land use analysis area (Figure 77). The land covered by the conservation easement offers opportunities for the continuation of forest and resource management, commercial timber harvesting and other commodity use, recreational characteristics, and open space, all of which provide fish and wildlife habitat. The conservation easement was mapped and reviewed during the transmission line screening analysis process (ERO Resources Corp. 2006b).

Plum Creek lands not covered by the conservation easement are currently managed the same as easement lands (*i.e.*, timber harvest and other commodity use, recreation, and wildlife habitat). Because these lands are not subject to the conservation easement, future land uses by Plum Creek or subsequent owners could change to include activities prohibited by the easement (Parker 2008).

3.14.3.2 Kootenai National Forest Land Management Plan

Land management direction for the KNF is described in the following sections. Management prescriptions are specified for each MA by resource, including recreation, wildlife and fish, timber, soils, water, and air resources, minerals and geology, lands, and facilities.

3.14.3.2.1 Forest-wide Goals, Objectives, and Standards

Goals

Goals provide information on the long-range management intent. The objectives and standards of both the forest as a whole and individual MAs must support the goals. All activities conducted on the KNF must contribute to the realization of the goals (KFP Vol. 1 II-1). The goal for mineral development, discussed under Goal #11 is to “encourage responsible development of mineral resources in a manner that recognizes national and local needs and provides for economically and environmentally sound exploration, extraction, and reclamation.” (KFP Vol. 1 II-2). The KFP also establishes a goal of providing a sustained yield of timber volume responsive to market demands and supportive of a stable base of economic growth in the dependent geographic area (KFP Vol. 1 II-1 #1).

Goals for wildlife resources include: (1) maintaining and enhancing sufficient habitat to facilitate recovery of threatened and endangered species (KFP Vol. 1 II-1 #6); (2) maintaining diverse age classes of vegetation to support viable populations of existing vertebrate species, including old growth dependent species (KFP Vol. 1 II-1 #7); (3) managing for sufficient snags (dead standing trees) to maintain viable populations of snag-dependent species (KFP Vol. 1 II-1 #8); and (4) maintaining big game and fisheries habitat (KFP Vol. 1 II-2 #12, #13).

For water quality, the KFP establishes a goal of meeting or exceeding state water quality standards (KFP Vol. 1 II-1 #19). To achieve this goal, forest-wide objectives for water quality require application of practicable mitigation measures, including those identified in the Soil and Water Conservation Handbook (USDA Forest Service 1988b).

Objectives

Mineral exploration and development may occur on nearly all areas of the KNF; areas withdrawn from future mineral entry include the CMW and developed recreation sites. MMC currently holds mineral rights inside the CMW established prior to the legislatively mandated withdrawal date. The objective concerning minerals requires consideration of other resources during mineral exploration and development (KFP Vol. 1 II-8).

Objectives for facility corridors, such as a transmission line, are discussed under Corridors in the KFP. The objectives establish corridor exclusion, avoidance, and window areas to assist in corridor siting (KFP Vol. 1 II-11). Criteria for these areas are outlined in Appendix 15, Corridor Criteria, of the KFP. Goals and objectives for cultural resources, recreation, visual resources, air quality, road management, and riparian areas have also been established and are described in the KFP (KFP Vol. 1 II-5, II-6, II-10, II-11). These are described in other sections of this chapter.

Standards

The minerals standard requires the KNF to "recognize the value and importance of the mineral resource in management activities" (KFP Vol. 1 II-27). Road access for mineral development "will be allowed if it is the next logical step in the development of the mineral resource," subject to the restriction of various laws, such as the Wilderness Act and the Endangered Species Act. Plans of Operations for mineral development must include "reasonable and justified" requirements designed to minimize environmental impacts (KFP Vol. 1 II-27). Under the minerals standard, the KNF will provide guidance to the mineral industry, where possible, to assist in developing mining plans that minimize environmental damage (KFP Vol. 1 II-27).

3.14.3.2.2 Management Area Goals and Standards

The KFP describes the goals and standards for 24 MAs located on the forest. The MAs within or adjacent to the land use analysis area are described in the following sections (maps of these management areas are available from KNF). The standards are summarized in Table 108. MAs classified as corridor exclusion or corridor avoidance areas are shown on Figure 78.

For all MAs discussed in the following sections, the standard for minerals refers to the forest-wide standards described in the above section. In all MAs, soil and water conservation practices are to be implemented for all developmental activities.

Semi-primitive Non-motorized Recreation (MA 2). The goal of MA 2 is to provide the protection and enhancement areas for roadless recreation use and to provide for wildlife management where specific wildlife values are high. In some areas, this MA provides habitat that will contribute to grizzly bear recovery. Some roads are currently open to some form of motorized recreational use, including snowmobiles. Roads may be justified for mineral activities. This MA is classified as a corridor avoidance area (KFP Vol. 1 III-5).

Table 108. Summary of Relevant Standards in Selected Management Areas on the KNF.

Management Area	Locatable Mineral Development	Powerline Corridors	Lands and Facility Occupancy	Motorized Access	Wildlife	Logging	Visual Quality Objective	Road Development
Semi-primitive non-motorized recreation (MA 2)	Forest-wide standards apply	Avoidance area	Frequently used facilities normally prohibited	Closed, except for limited exceptions	Grizzly habitat	Unsuitable	Retention	Generally prohibited; existing roads may be used for mineral development on a case-by-case basis; new roads permitted when justified by mineral information
Developed recreation sites (MA 6)	Restricted	Avoidance area	Permitted	Restricted	Provide habitat	Unsuitable	Partial retention	Restricted
Big game winter range (MA 10)	Forest-wide standards apply	Avoidance area	Permitted with winter restrictions	Closed during winter	Maintain openings for big game	Unsuitable	See footnotes†‡	Restricted
Big game winter range/timber (MA 11)	Forest-wide standards apply	Avoidance area	Permitted with winter restrictions	Closed during winter	Maintain openings for big game	Suitable	See footnotes†‡	Restricted
Big game summer range (MA 12)	Forest-wide standards apply	Avoidance area	Frequently used facilities normally prohibited	Roads generally closed	Big game and grizzly habitat	Suitable	See footnote†	Restricted
Designated old growth timber (MA 13)	Forest-wide standards apply	Avoidance area	Restricted	Prohibited during summer/fall	Grizzly bear and old growth species habitat	Unsuitable	See footnotes†‡	Restricted
Grizzly habitat (MA 14)	Forest-wide standards apply	Avoidance area	Generally prohibited	Allowed, with restrictions	Grizzly habitat	Suitable	See footnote†	Restricted during active grizzly use
Timber production (MA 15)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Maximum modification	Allowed

Table 108. Summary of Relevant Standards in Selected Management Areas on the KNF. (cont'd).

Management Area	Locatable Mineral Development	Powerline Corridors	Lands and Facility Occupancy	Motorized Access	Wildlife	Timber Production	Visual Quality Objective	Road Development
Timber with viewing (MA 16)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Modification	Allowed
Viewing with timber (MA 17)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Suitable	Partial retention	Allowed
Revegetation problem areas (MA 18)	Forest-wide standards apply	Permitted	Permitted	Allowed	Provide habitat	Unsuitable	See footnote†	Restricted
Electric Transmission Corridor (MA 23)	Forest-wide standards apply	Permitted	Permitted	Allowed, with possible public access restriction	Grizzly habitat	Unsuitable	Maximum modification	Allowed
Low Productivity Areas (MA 24)	Forest-wide standards apply	Case-by-case basis	Case-by-case basis	Allowed, with restrictions	Grizzly habitat	Unsuitable	See footnote†	Restricted
Mineral Development (MA 31)	Forest-wide standards apply	Case-by-case basis consistent with mineral production facility	Case-by-case basis consistent with mineral production facility	Allowed	Locate facilities, if possible, away from important winter range, calving areas, riparian areas, and meadows	Unsuitable	Maximum modification	Allowed

†Maximum modification in areas of low visual significance, modification in areas of moderate visual significance, and partial retention in areas of high visual significance.
‡Unless infeasible when attempting to meet the goals of the Management Area.
Source: USDA Forest Service 1987.

Developed Recreation Sites (MA 6). MA 6 includes developed campgrounds, picnic areas, boat ramps, and other developed recreation sites. Areas are usually associated with water features such as lakes, reservoirs, and streams. The goal of MA 6 is to provide safe and sanitary developed recreation in a setting that is pleasant and visually attractive. This MA is usually withdrawn from mineral development, and is classified as a corridor avoidance area (KFP Vol. 1 III-18).

Big Game Winter Range (MA 10). The goal of MA 10 is to maintain or enhance the habitat effectiveness for winter use by big-game species including elk, moose, sheep, goats, whitetail deer, and mule deer. The goal also is to maintain or enhance visual resources in areas visible from major travel corridors. This MA is classified as a corridor avoidance area (KFP Vol. 1 III-40).

Big Game Winter Range/Timber (MA 11). The goal for MA 11 is to maintain and enhance winter range habitat effectiveness for big game species while also producing a programmed yield of timber and maintaining the scenic resource in areas of high visual significance. The standards concentrate on protection of important wintering areas and providing optimum habitat for elk, mule deer, whitetail deer, moose, sheep, and goats for winter survival. These areas are corridor avoidance areas in grizzly bear habitat. Programmed timber harvest is authorized (KFP Vol. 1 III-45).

Big Game Summer Range/Timber (MA 12). The goal for MA 12 emphasizes maintenance or enhancement of summer and fall big game habitat while producing a programmed yield of timber. The goals and standards focus on providing big game habitat diversity for black bear, grizzly bear, elk, moose, mule deer, and whitetail deer. Timber production will be maintained through cultural treatments and regeneration harvest designed to reduce the frequency of entries. Facilities that require frequent maintenance or occupancy are normally not allowed. This MA is a corridor avoidance area in areas important to grizzly bear use (KFP Vol. 1 III-51).

Designated Old Growth Timber (MA 13). MA 13 provides the special habitat necessary for old growth-dependent wildlife on at least 10 percent of the land area within each major drainage, and in units that represent the major habitat types and tree species of each drainage. The standards emphasize providing diverse, high quality, year-round habitat for old growth-dependent wildlife (usually other than big game) by relying on natural processes of stand aging, decadence and eventual deterioration. This MA is classified as a corridor avoidance area (KFP Vol. 1 III-56).

Grizzly Bear Habitat/Timber (MA 14). MA 14 is designed to maintain or enhance grizzly bear habitat, reduce grizzly/human conflicts, assist in the recovery of the grizzly bear, realize a programmed level of timber production, and provide for the maintenance or enhancement of other wildlife, especially big game. Identified grizzly habitat components will be maintained or enhanced, and key components such as wet meadows and bogs will be mapped and managed as riparian areas. This MA is classified as a corridor avoidance area (KFP Vol. 1 III-60).

Timber Production (MA 15). The goal of MA 15 is to produce timber volumes suitable for harvest by conventional methods while providing for other resource values such as soil, air, water, wildlife, recreation and forage for domestic livestock. This MA has standards and guidelines for providing optimum timber production by ensuring full stocking through natural and artificial regeneration, and maintaining optimal volume growth through stocking control by thinning. Most roads are available for motorized recreation. Transmission line corridors are permitted (KFP Vol. 1 III-66).

Timber with Viewing (MA 16). The goal of MA 16 is to produce timber while providing for a pleasing view. This MA is characterized by productive forest land that has moderate viewing sensitivity. There are no identified habitats for threatened or endangered species. Most roads are available for motorized recreation. Transmission line corridors are permitted (KFP Vol. 1 III-71).

Viewing with Timber (MA 17). The goal of MA 17 is to provide landscapes that are pleasing to the viewer, while producing a level of timber production that is compatible with visual resource protection. Roads are generally located so they are not visible from major travel corridors. Transmission line corridors are permitted (KFP Vol. 1 III-76).

Regeneration Problem Areas (MA 18). MA 18 occurs on areas of slope in excess of 40 percent where timber productivity is moderate to high. This MA is distinguished by the difficulty in establishing coniferous regeneration after timber harvest. The goals of this MA are to maintain the existing coniferous vegetation until techniques and practices are available to ensure that timber can be harvested and the area adequately regenerated within 5 years of harvest, and to maintain viable populations of existing native wildlife species. Because of the sensitivity of MA 18, water quality and soil erosion will be monitored as part of any surface disturbance activity. Transmission line corridors are permitted (KFP Vol. 1 III-81).

Electric Transmission Corridor (MA 23). The goal for MA 23 is to provide for the transmission of electricity in a safe and efficient manner. The goal is also to protect the adjacent wilderness character, contribute to the diversity of surrounding wildlife habitat, and provide as much security as possible for the grizzly bear. The VQO is maximum modification (KFP Vol. 1 III-113).

Mineral Development (MA 31). The goal of MA 31 is to provide mineral production workers with safe and healthful working areas 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. The VQO is maximum modification (KFP amendments).

Riparian Areas. In 1995, the KNF amended the KFP to adopt the INFS (USDA Forest Service 1995) to establish stream, wetland, and landslide-prone area protection zones called RHCAs. These RHCAs are designated along most of the streams in the land use analysis area. Section 3.6, *Aquatic Life and Fisheries* provides more information about the standards and guidelines for managing activities within a RHCA.

3.14.4 Environmental Consequences

3.14.4.1 Alternative 1 – No Mine

The changes in land use associated with a mine would not occur. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Disturbances on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals. Use of National Forest System lands would continue to be managed in accordance with the KFP. Existing land use of private land in the Little Cherry Creek Tailings Impoundment Site and along the Bear Creek Road (NFS road #278) would continue.

3.14.4.2 Alternative 2 – MMC's Proposed Mine

Direct Effects

Most of the proposed mine facilities would be on National Forest System lands. The management emphasis of these lands is listed in Table 109. Most of the lands are currently managed for mineral development, wildlife habitat, recreation, and commercial timber production. During the life of the operation, use of the lands within the permit areas would be devoted to mining and associated activities. The permitted area and the disturbance along the Bear Creek access road (NFS road #278) would total 3,405 acres (Table 109); about 2,582 acres would be disturbed. Adjacent land use during the operation would be affected to some extent; these impacts are described in other sections on recreation, noise, scenic resources, and wildlife. The Libby Adit Site and portions of the Little Cherry Creek Impoundment Site (424 acres) are private lands owned by MMC (Table 109). LAD Area 2 would be immediately adjacent to private land along Libby Creek (Figure 77). Widening of the Bear Creek Road would affect about 7.6 acres of private land in three separate parcels between 1 and 3 miles south of the road's intersection with U.S. 2.

All lands disturbed by the project would be revegetated and, except for the Bear Creek Road and the tailings impoundment facilities, would return to pre-mine uses and productivity over time. The Bear Creek Road from U.S. 2 to the Bear Creek Bridge would not be restored to its narrower pre-mining width. Successful reclamation would result in reforestation of disturbed lands. The goal of reclamation would be to restore lands to productive use (see section 3.18, *Soils and Reclamation*). The Little Cherry Creek Tailings Impoundment and the upper part of the Diversion Channel would not support pre-mining timber production. The disturbance associated with the Bear Creek Road widening also would not support pre-mining timber production.

3.14.4.2.1 Forest Plan Amendment

A KFP amendment would be needed for portions of the mine permit areas that are not currently designated for mineral development (MA 31). A few areas currently designated for mineral development also would need to be reallocated to other Management Areas. Alternative 2 would require an amendment on 1,916 acres; 1,886 acres would be reallocated to MA 31 and 30 acres would be reallocated back to the MAs shown in Table 110. Under MA 31, land management in the mine permit areas would change from the present direction for uses listed in Table 110 to long-term management for mineral development. The MA that would require the most change is currently MA 14, which is managed for grizzly bear habitat. Because the permit area at the Ramsey Plant Site is better defined than in 1993, 25 acres at the site would be reallocated from MA 31 back to MA 2, semi-primitive non-motorized recreation. Similarly, 5 acres at the Little Cherry Creek Impoundment Site would be reallocated back to MA 14, grizzly bear habitat. Maps showing areas of proposed reallocation are available at the KNF.

Table 109. Management Area (MA) Allocation of Lands within Proposed Permit Areas and along Bear Creek Access Road.

Management Area	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment Alternative	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative
National Forest System lands			
MA 2-Semi-primitive non-motorized recreation	227	178	178
MA 11-Big game winter range/timber	20	20	20
MA 13-Old growth	341	259	289
MA 14-Grizzly habitat	1,006	1,481	1,115
MA 16-Timber with viewing	501	134	502
MA 17-Viewing with timber	34	<1	34
MA 23-Electric transmission corridor	65	23	23
MA 31-Mineral development	1,078	490	728
Subtotal	3,272	2,585	2,889
Private land			
MMC-owned	425	75	425
Other Private	8	8	8
Subtotal	433	83	433
Total	3,705	2,668	3,322

All units are in acres.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 110. Acres of National Forest System Land to be Reallocated to Management Area 31 (Mineral Development) for each Mine Alternative.

Management Area Allocation	Alternative 2 – MMC's Proposed Mine			Alternative 3 – Agency Mitigated Poorman Impoundment Alternative			Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative		
	To MA 31	From MA 31	Net to MA 31	To MA 31	From MA 31	Net to MA 31	To MA 31	From MA 31	Net to MA 31
MA 2-Semi-primitive non-motorized recreation	208	25	183	160	150	10	160	150	10
MA 13-Old growth timber†	336	0	336	252	0	252	284	0	284
MA 14-Grizzly habitat	815	5	810	1,363	466	897	951	228	723
MA 16-Timber with viewing	473	0	473	106	0	106	473	0	473
MA 17-Viewing with timber	34	0	34	0	0	0	34	0	34
MA 23-Electric transmission corridor	20	0	20	23	2	21	23	2	21
Total	1,886	30	1,856	1,904	618	1,286	1,925	380	1,545

Acreage based on the permit areas surrounding the adit sites, plant site, tailings impoundment, and LAD Areas.
†The KNF would reallocate 587 acres of old growth in Alternative 3 and 659 acres in Alternative 4 to MA 13 (Table 145). The stands of old growth have not been identified specifically, and would be before issuance of a ROD.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.14.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Like Alternative 2, most of the proposed mine facilities would be on National Forest System lands currently managed for wildlife habitat, recreation, mineral development, and commercial timber production. The management emphasis of these lands is shown in Table 109. During the life of the operation, use of the lands within the permit areas would be devoted to mining and associated activities. The permitted area and the disturbance along the Bear Creek access road (NFS road #278) would total 2,668 acres (Table 109); about 2,011 acres would be disturbed. Effects of Alternative 3 would be similar to Alternative 2. The Libby Adit Site is private land owned by MMC. The Poorman Impoundment Site and LAD Area 2 would be immediately west of private land along Libby Creek. Widening of the Bear Creek Road would affect about 7.6 acres of private land in three separate parcels between 1 and 3 miles south of the road's intersection with U.S. 2.

All lands disturbed by the project would be revegetated and, except for the Bear Creek Road and the tailings impoundment facilities, would return to pre-mine uses and productivity over time. The Poorman Tailings Impoundment and the disturbance associated with the Bear Creek Road widening would not support pre-mining timber production.

Alternative 3 would require a KFP amendment of 2,522 acres; 1,904 acres would be reallocated to MA 31 and 618 acres would be reallocated back to the MAs shown in Table 110. Under MA 31, land management in the mine permit areas would change from the present direction for uses listed in Table 110 to long-term management for mineral development. The MA that would require the most change is MA 14, which currently is managed for grizzly bear habitat. Because the permit area would not include Ramsey Plant Site, 150 acres at the Ramsey Plant Site would be reallocated back to MA 2, semi-primitive non-motorized recreation. Similarly, 466 acres at the Little Cherry Creek drainage (outside of the permit area for the tailings impoundment) would be reallocated back to MA 14, grizzly bear habitat. Maps showing areas of proposed reallocation are available at the KNF.

3.14.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Like the other alternatives, most of the proposed mine facilities in Alternative 4 would be on National Forest System lands currently managed for grizzly bear habitat (Table 109). Management emphasis of the permit area of other facilities is mineral development, recreation, and commercial timber production. During the life of the operation, use of the lands within the permit areas would be devoted to mining and associated activities. The permitted area and the disturbance along the Bear Creek access road (NFS road #278) would total 3,322 acres (Table 109); about 2,248 acres would be disturbed. Effects of Alternative 4 would be similar to Alternative 2. Land use of private land at the Libby Adit Site and the Little Cherry Creek Impoundment Site, which is owned by MMC, would not change. Widening of the Bear Creek Road would affect about 7.6 acres of private land in three separate parcels between 1 and 3 miles south of the road's intersection with U.S. 2.

All lands disturbed by the project would be revegetated and, except for the Bear Creek Road and the tailings impoundment facilities, would return to pre-mine uses and productivity over time. The Little Cherry Creek Tailings Impoundment, upper part of the Diversion Channel, and the

disturbance associated with the Bear Creek Road widening would not support pre-mining timber production.

The KFP would be amended to change the management allocation to mineral development (MA 31) on 2,305 acres from the present direction for uses listed in Table 110. About half the area is currently MA 14, which is managed for grizzly bear habitat. The permit area would not include Ramsey Plant Site, and 150 acres at the Ramsey Plant Site would be reallocated from MA 31 back to MA 2, semi-primitive non-motorized recreation. Similarly, 228 acres at the Little Cherry Creek Impoundment Site outside of the permit area for the tailings impoundment would be reallocated back to MA 14, grizzly bear habitat. Maps showing areas of proposed reallocation are available at the KNF.

3.14.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. No changes in land use in Alternative A would occur. Use of National Forest System lands would continue to be managed in accordance with the KFP. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Existing land use of state land along West Fisher Creek, Plum Creek lands, and private land along U.S. 2 and at scattered parcels in the Miller Creek, West Fisher Creek and Standard Creek drainages would continue.

3.14.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

3.14.4.6.1 Direct Effects

In the North Miller Creek Alternative, the alignment would cross Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River (Figure 77). These segments would parallel an existing road corridors (roads on Plum Creek lands, U.S. 2 and NFS road #385). About 9.3 miles of the North Miller Creek Alternative (Alternative B) would be within 1,000 feet of open roads on Plum Creek lands, U.S. 2 or open roads on National Forest System lands, such as NFS road #231 or #278 (Table 111).

Table 111. Use of Existing Road Corridors.

Alternative	Miles of Centerline within 1,000 Feet of Existing Road Corridors
Alternative B –North Miller Creek Alternative	9.3
Alternative C – Modified North Miller Creek	8.5
Alternative D –Miller Creek	12.0
Alternative E – West Fisher Creek	11.1

Source: GIS analysis by ERO Resources Corp. using KNF data.

All transmission line alternatives would include the Sedlak Park Substation and loop line (steel monopoles would be used). The Sedlak Park Substation and loop line would affect 4.4 acres of Plum Creek land, all of which are covered by the conservation easement. About 7.2 miles of Plum Creek land would be crossed, 5.4 miles of which are covered by the conservation easement with FWP (Table 112). Two sections of Plum Creek land west of the Fisher River are not covered by the

conservation easement with FWP. Clearing of up to 129 acres of Plum Creek land, which is compatible with Plum Creek's land management, would be needed for the transmission line. About 10 acres of additional clearing would be needed for access road construction on private lands (Table 113). Following construction, the transmission line could restrict cable logging in areas adjacent to the line. Plum Creek land is managed primarily for timber production; some dispersed recreation also occurs on Plum Creek land. This alternative would cross less than 0.1 mile of other private land near the Fisher River.

The remaining 9.3 miles of North Miller Creek Alternative would be on National Forest System lands managed by the KNF. Because the alternative uses the same alignment that was approved in 1993, about a third of the alignment (3.1 miles) would cross lands currently managed for electric transmission corridors. The line would cross 3.0 miles of land that the KFP has identified as corridor avoidance areas (Figure 78; Table 112). Of the 3.0 miles of corridor avoidance areas, most (2.5 miles) are currently managed for big game winter range (MA 11), with the remaining 0.5 mile is split between four different MAs (Table 112). Fourteen residences are within 0.5 mile of this alignment (Figure 78), of which 11 are greater than 450 feet from the centerline of the ROW and the remaining three are within 450 feet (Asher Sheppard Consulting 2007). The alternative would pass through the Libby Creek Recreational Gold Panning Area for a distance of 1,761 feet (see section 3.15, *Recreation*).

All transmission line alternatives would require construction of between 3 and 10 new access roads or extensive upgrading of existing access roads (see Table 113). About 1.9 miles of roads would be constructed in areas where road construction is allowed under the KFP, and 5 miles of roads would be in areas where road construction is restricted in some manner (Table 113). For example, MA 11 indicates roads will normally be closed during big game winter use (December 1 to April 30). MMC proposes to restrict motorized activity associated with transmission line construction from April 1 to June 15 within bear habitat in the Miller Creek and Midas Creek drainages. MMC also would restrict transmission line construction during the winter in big-game winter range areas (MA 11).

3.14.4.6.2 Forest Plan Amendment

The North Miller Creek Alternative would require a KFP amendment on 302 acres; 220 acres would be reallocated to MA 23 and 82 acres would be reallocated from MA 23 to the MAs shown in Table 114. Under MA 23, land management along the line would change from the present direction for uses listed in Table 114 to long-term management as a transmission line corridor. The MA that would require the most change is MA 11, which currently is managed for big game winter range and timber production.

About 44 acres in the Ramsey Creek drainage would be reallocated from MA 23 to MA 2, 9 acres in the land use analysis area would be reallocated to MA 6, 11 acres would be reallocated to MA 13, and 17 acres would be reallocated to MA 14 (Table 114). Maps showing areas of proposed reallocation are available at the KNF.

Table 112. Management Area (MA) Allocation and Land Ownership of Each Transmission Line Alternative Excluding Sedlak Park Substation and Loop Line.

Management Emphasis	Alternative B – North Miller Creek		Alternative C – Modified North Miller Creek		Alternative D – Miller Creek		Alternative E – West Fisher Creek	
	(ac.)†	(mi.)	(ac.)†	(mi.)	(ac.)†	(mi.)	(ac.)†	(mi.)
National Forest System Land-transmission line corridor avoidance areas								
MA 6-Developed recreation sites	1	<0.1	1	<0.1	7	0.3	7	0.3
MA 11-Big game winter range/timber	44	2.5	63	2.6	39	1.6	83	3.5
MA 12-Big game summer range	5	0.3	8	0.3	55	2.3	42	1.7
MA 13-Old growth	3	0.1	0	0	6	0.2	6	0.2
MA 14-Grizzly habitat	2	0.1	1	0	1	0	2	<0.1
Subtotal	55	3.0	73	2.9	108	4.4	140	5.7
National Forest System Land-transmission line corridors allowed								
MA 15-Timber production	24	1.3	31	1.3	9	0.4	6	0.3
MA 16-Timber with viewing	0	0	<1	<0.1	34	1.4	34	1.4
MA 18-Regeneration problem areas	26	1.5	29	1.2	0	0.0	0	0.0
MA 23-Electric transmission corridor	54	3.1	23	1	12	0.5	12	0.5
MA 31-Mineral development	8	0.4	0	0	0	0	0	0
Subtotal	112	6.3	83	3.5	55	2.3	52	2.2
State Land	0	0.0	0	0.0	0	0.0	24	1.2
Private Land								
Plum Creek with conservation easement	97	5.4	128	5.3	128	5.3	103	4.2
Other Plum Creek	32	1.8	40	1.7	41	1.7	30	1.3
Other private	1	<0.1	0	0	11	0.4	4	0.2
Subtotal Private	130	7.2	168	6.9	180	7.4	137	5.7
Total	297	16.4	324	13.4	343	14.1	355	14.9

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.
Totals may vary slightly due to rounding.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 113. Estimated Road Construction or Reconstruction in Each Transmission Line Alternative.

MA Direction on Road Development†	Alternative B – North Miller Creek		Alternative C – Modified North Miller Creek		Alternative D – Miller Creek		Alternative E – West Fisher Creek	
	(ac.)	(mi.)	(ac.)	(mi.)	(ac.)	(mi.)	(ac.)	(mi.)
National Forest System Lands - Road Construction Allowed (MAs 15, 16, 17, 23, 31)	5.8	1.9	0.3	0.1	1.8	0.6	1.8	0.6
National Forest System Lands - Road Construction Restricted (MAs 2, 6, 10, 11, 12, 13, 14, 17, 18, 24)	14.7	5.0	2.3	0.8	1.6	0.6	5.0	1.7
State Lands	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2
Private Lands	10.0	3.4	6.6	2.2	6.6	2.2	5.4	1.7
Total	30.5	10.3	9.2	3.1	10.0	3.4	12.7	4.2

New roads and roads with extensive requirements for upgrading are assumed to be 25 feet wide. Values are rounded to the nearest 0.1 acre and mile, and conversion between the two may vary due to rounding.
†(See Table 108.)
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 114. Acres of KNF land to be Reallocated to Management Area 23 (Electric Transmission Corridor) for each Transmission Line Alternative.

Management Area Emphasis	Timber Harvest	Alternative B – North Miller Creek			Alternative C – Modified North Miller Creek			Alternative D – Miller Creek			Alternative E – West Fisher Creek		
		To MA 23	From MA 23	Net to MA 23	To MA 23	From MA 23	Net to MA 23	To MA 23	From MA 23	Net to MA 23	To MA 23	From MA 23	Net to MA 23
MA 2-Semi-primitive non-motorized recreation	Unsuitable	16	44	-29	0	126	-126	0	126	-126	0	126	-126
MA 6-Developed recreation sites	Unsuitable	9	9	-1	9	9	-1	25	21	4	25	21	4
MA 10-Big game winter range	Unsuitable	0	0	0	0	0	0	0	0	0	4	0	4
MA 11-Big game winter range/Timber	Suitable	145	0	145	153	0	153	97	0	97	206	0	206
MA 12-Big game summer range	Suitable	19	0	19	20	0	20	137	0	137	106	0	106
MA 13-Old growth timber[†]	Unsuitable	15	11	4	0	23	-23	14	23	-9	15	23	-8
MA 14-Grizzly habitat	Suitable	17	17	-1	9	26	-18	6	41	-34	11	41	-29
Total		220	82	138	190	184	6	279	210	69	366	210	156

Acreage calculated on the basis of a 500-foot corridor along transmission line centerline to allow for flexibility during final design of the line.
[†]The KNF would reallocate 39 acres of old growth in Alternative C and, in addition, 64 acres in Alternatives D and E (Table 146). The stands of old growth have not been identified specifically, and would be before issuance of a ROD.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.14.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

3.14.4.7.1 Direct Effects

The Sedlak Park Substation and loop line would affect 4.4 acres of Plum Creek land, all of which are covered by the conservation easement. The Modified North Miller Creek Alternative would affect Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River similar to the North Miller Creek Alternative (Figure 77). About 6.9 miles of Plum Creek land would be crossed, 5.3 miles of which are covered by the conservation easement with FWP. No other private land would be affected (Table 112). This alternative would use H-frame structures, which have a wider clearing width than the monopoles proposed in Alternative B; up to 168 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction (Table 113). Alternative C would make the least use of existing road corridors, with 8.5 miles within an existing road corridor (Table 111).

The remaining 6.4 miles of the Modified North Miller Creek Alternative would be on National Forest System lands with a management area allocation shown in Table 112. The line would cross 2.9 miles of corridor avoidance areas (Table 112). Of the 2.9 miles of corridor avoidance areas, most (2.6 miles) currently are managed for big game winter range (MA 11). All seven residences within 0.5 mile of this alignment are more than 450 feet from the centerline (Asher Sheppard Consulting 2007). Like Alternative B, Alternative C would pass through the Libby Creek Recreational Gold Panning Area in the same location.

A minimum of 20 structures (about 3.3 miles of line) would be set using a helicopter, minimizing new access road construction or extensive upgrading of closed roads). Additional structures may be set using a helicopter at the contractor's discretion. About 0.1 mile of roads would be constructed in areas where road construction is allowed under the KFP, and 0.8 mile of roads would be in areas where road construction is restricted in some manner (Table 113).

3.14.4.7.2 Forest Plan Amendment

The Modified North Miller Creek Alternative would require 190 acres of KNF land be changed from the MA designation shown in Table 114 to MA 23; 184 acres would be changed from MA 23 to the MA shown in Table 114. Most of the lands that would be reallocated to MA 23 would be MA 11, big game winter range/timber, and big game summer range.

Most of the land that would be reallocated from MA 23 (126 acres) would be allocated to MA 2 in the Ramsey Creek drainage. In the land use analysis area, 9 acres would be reallocated from MA 23 to MA 6, 23 acres would be reallocated to MA 13, and 26 acres would be reallocated to MA 14 (Table 114). Maps showing areas of proposed reallocation are available at the KNF.

3.14.4.8 Alternative D – Miller Creek Transmission Line Alternative

3.14.4.8.1 Direct Effects

The Miller Creek Alternative would have essentially the same effect on Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River as the Modified North Miller Creek Alternative. This alternative also would use H-frame structures; up to 169 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction. It would make best use of existing road corridors, with 12 miles with 1,000 feet of existing, open roads (Table 111).

Two other private land parcels would be affected (Figure 77). The line would be on the north side of a private parcel with a cabin along Miller Creek (Figure 78). It also would cross the northeast corner of a private parcel south of Howard Lake. A residence has recently been built on the south end of this parcel. Preliminary design indicates one H-frame structure and one access road to the structure would be needed on each parcel. A total of 11 acres of clearing would be required on the two parcels (Table 112).

The remaining 6.7 miles of the Miller Creek Alternative would be on National Forest System lands with a management emphasis shown in Table 112. The line would cross 4.4 miles of corridor avoidance areas, most of which (3.9 miles) currently are managed for big game winter and summer range (MAs 11 and 12 – Table 112). All seven residences within 0.5 mile of this alignment are more than 450 feet from the centerline (Asher Sheppard Consulting 2007). The alignment would pass through the Libby Creek Recreational Gold Panning Area for a distance of 2,118 feet (see section 3.15, *Recreation*).

A minimum of 20 structures (about 2 miles of line) would be set using a helicopter; additional structures may be set using a helicopter at the contractor's discretion. About 0.6 mile of roads would be constructed in areas where road construction is allowed under the KFP, and 0.6 mile of roads would be in areas where road construction is restricted in some manner (Table 113).

3.14.4.8.2 Forest Plan Amendment

The Miller Creek Alternative would require a KFP amendment on 489 acres; 279 acres would be reallocated to MA 23 and 210 acres would be reallocated from MA 23 to the MAs shown in Table 114. The MA that would require the most change is MA 11, which currently is managed for big game winter range and timber production.

Like Alternative C, most of the land that would be reallocated from MA 23 (126 acres) would be allocated to MA 2 in the Ramsey Creek drainage. As shown in Table 114, 21 acres in the land use analysis area would be reallocated from MA 23 to MA 6, 23 acres would reallocated to MA 13, and 41 acres would be reallocated to MA 14. Maps showing areas of proposed reallocation are available at the KNF.

3.14.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

3.14.4.9.1 Direct Effects

The West Fisher Creek Alternative would have less effect on Plum Creek land than the other alternatives, crossing 6.7 miles of Plum Creek lands and 4.2 miles of lands covered under the conservation easement. This alternative would use H-frame structures, except in the section of state land west of the Fisher River (Figure 77). Up to 157 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction. The Sedlak Park Substation and loop line would affect 4.4 acres of Plum Creek land, all of which are covered by the conservation easement.

One private land parcel south of Howard Lake would be affected (Figure 77). This alternative would have the same effect on this parcel as the Miller Creek Alternative. Preliminary design indicates one H-frame structure would be needed on the parcel. Up to 4 acres of clearing would be required on the parcel (Table 112). This alternative would cross 1.2 miles of state land managed for timber harvest (Table 112). Up to 24 acres of state land would require clearing for construction of the transmission line.

The remaining 6.7 miles of the West Fisher Creek Alternative would be on National Forest System lands with a management emphasis shown in Table 112. The line would cross 4.4 miles of corridor avoidance areas, most of which currently are managed for big game winter and summer range (MAs 11 and 12 – Table 112). Six residences are within 0.5 mile of this alignment, of which four are more than 450 feet from the line and the remaining two are within about 450 feet of the centerline (Asher Sheppard Consulting 2007). The alignment would pass through the Libby Creek Recreational Gold Panning Area. About 11.1 miles of the centerline would be with 1,000 feet of existing, open roads (Table 111).

A minimum of 23 structures (about 2.4 miles of line) would be set using a helicopter; additional structures may be set using a helicopter at the contractor's discretion. About 0.6 mile of roads would be required in areas where road construction is allowed under the KFP, and 1.7 miles of roads in areas where road construction is not allowed (Table 113).

3.14.4.9.2 Forest Plan Amendment

The West Fisher Creek Alternative would require 366 acres of KNF land be changed from the MA designation shown in Table 114 to MA 23; 210 acres would be changed from MA 23 to the MA shown in Table 114. Most of the lands that would be reallocated to MA 23 would be MA 11, big game winter range/timber, and big game summer range.

Most of the land in the Ramsey Creek drainage that would be reallocated from MA 23 would be allocated to MA 2. As shown in Table 114, 21 acres in the land use analysis area would be reallocated from MA 23 to MA 6, while 23 acres would be reallocated to MA 13, and 41 acres would be reallocated to MA 14. Maps showing areas of proposed reallocation are available at the KNF.

3.14.4.10 Cumulative Effects

Past actions, such as past mining and road construction, have altered the existing land use. Areas disturbed by past mining and road construction do not provide for timber production or wildlife habitat. Past KFP amendments have changed the MA designations of National Forest System lands. In 1987 when the KFP was issued, the KNF had 1,690 acres allocated to MA 23; MA 31 was not established. Since 1987, the KFP has been amended to allocate 3,473 acres to MA 23 and 1,245 acres to MA 31. In the land use cumulative effects analysis area, previous amendments have allocated 233 acres to MA 23 and 1,108 acres to MA 31. The Rock Creek Project and the Montanore Project would cumulatively increase the amount of National Forest System lands on the KNF managed for transmission line corridors and mineral development.

3.14.4.11 Regulatory/Forest Plan Consistency

Following the amendments to the KFP described in this section and in section 2.12, *Forest Plan Amendment*, the mine and transmission line alternatives would be in compliance with the management area designations of the KFP. Other sections of Chapter 3 discuss compliance with the KFP. If the selected transmission line were approved by the FWP, it would be in compliance with the FWP-Plum Creek conservation easement.

3.14.4.12 Irreversible and Irretrievable Commitments

The tailings impoundment area, about 600 acres in each mine alternative, would be managed for mineral development following operations, and would no longer be managed as suitable for

timber production. The area covered by asphalt and gravel by widening the Bear Creek Road would not be returned to pre-mine uses. Timber would be harvested sooner in areas cleared for project facilities. Continued tree clearing along the transmission line would reduce timber production during the life of the project. These resources would be irretrievably affected. Any indirect development associated with the project, such as new permanent residential or commercial development in or around Libby, would likely be permanent.

3.14.4.13 Short-term Uses and Long-term Productivity

In the short term, mine operations would dominate land use on about 2,700 to 3,700 acres, depending on the alternative. Similarly, timber production on 300 to 350 acres, depending on the transmission line alignment, would be eliminated along the transmission line clearing width and access roads. Actual clearing width and lost timber production would be slightly less, and would depend on tree height, slope, and line clearance above the ground. After operations ceased, land uses in most areas affected by the mine, Sedlak Park Substation and loop line, and transmission line would return to pre-mine uses. In addition, an undetermined amount of private land would be acquired and legally dedicated to long-term grizzly bear habitat mitigation (see section 3.24, *Wildlife Resources*).

3.14.4.14 Unavoidable Adverse Environmental Effects

During mine and transmission line construction and operations, all action alternatives would unavoidably alter land use in the land use analysis area.

3.15 Recreation

3.15.1 Regulatory Framework

3.15.1.1 Kootenai Forest Plan

The Forest-wide Management Direction objectives for recreation outlined in the KFP allows for the maintenance and expansion of trails and developed recreation opportunities (such as campgrounds, picnic areas, and boat launches) as needed to prevent resource damage or to accommodate increased demand, and the expansion of groomed cross-country ski trails and snowmobile trails. The Forest Travel Planning process is used to review, evaluate, and implement the goals and standards of various MAs, with regard to roads, trails, and motorized vehicle use (USDA Forest Service 1987). MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. Management emphasis for individual MAs are described in section 3.14, *Land Use* (Table 108). Executive Order 12962 mandates disclosure of effects to recreational fishing.

3.15.1.2 State and Local Plans

The FWP manages wildlife populations and establishes limits on fishing and hunting activities statewide including on National Forest System lands. FWP has several general statewide goals that relate to recreational use in the analysis area (FWP 2009). FWP's goals are to provide quality opportunities for public appreciation and enjoyment of fish, wildlife, and parks resources, and maintain and enhance the health of Montana's natural environment and the vitality of its fish, wildlife, cultural, and historic resources through the 21st century. The FWP's goals are not enforceable standards. Lincoln County does not have a comprehensive recreation plan.

One parcel of state land is crossed by the West Fisher Creek alignment. The DNRC manages the surface and mineral resources for the benefit of the common schools and six administrative land offices, under the direction of the State Board of Land Commissioners. Hunting also occurs on state land (Power Engineers 2005c).

3.15.2 Analysis Area and Methods

The analysis area includes the area west of U.S. 2, primarily east of the Cabinet Mountains ridge line (except for a ventilation adit located near Rock Lake on the west side of the ridge line), south from the Bear Creek Road corridor and north from NFS road #231. The four transmission line alternative alignment corridors also are included in the analysis area.

A land use inventory of the analysis area, which refined and updated existing recreation-related data, was used for the evaluation of recreation effects (Power Engineers 2005c). One of the components contained in the land use inventory included parks, recreation, and preservation areas. The analysis of recreational impacts was based on the number of roads and trails proposed for closure and the effect these closures would have on recreational access in the area. In addition, secondary effects associated with diminished recreation quality on lands adjacent to mining activities were evaluated.

The analysis of potential changes to Recreation Opportunity Spectrum (ROS) characteristics was based on existing ROS designations provided by KNF. Anticipated changes to ROS

characteristics along existing and proposed road corridors, adjacent to proposed mine facilities, and along proposed transmission line corridors were mapped and quantified. These anticipated changes are described in this section. Maps showing existing and anticipated ROS characteristics are available in the project record.

3.15.3 Affected Environment

3.15.3.1 Recreational Opportunities and Uses

Northwest Montana is known for its lakes, rivers, and mountains that provide a variety of recreational opportunities. National Forest System lands make up a large percentage of the Lincoln County land base and offer public access for a variety of motorized and non-motorized recreational activities including: hunting for big game and upland game birds, fishing, hiking, wildlife observation, photography, backpacking, horseback riding, snowmobiling, cross-country skiing, mountain biking, picnicking, sightseeing, off highway vehicle (OHV) use, rock hounding, and camping. Recreational use in the analysis area occurs largely within the 350,000-acre Libby Ranger District. Recreational use of the Libby Ranger District is highest in the summer with camping, hiking, and fishing on the weekends being the major activities. These activities in the analysis area are concentrated at Howard Lake and along popular hiking trails. Recreation activities continue to take place during fall, although use declines. Fall use of the analysis area is mainly dispersed hunting and berry picking.

In the last two decades, the number and types of users have increased in the analysis area, partly as a result of growth in the Flathead Valley and Missoula (Kocis *et al.* 2003). The analysis area provides different types of user experiences; the CMW and the small drainages provide users with a more solitary experience compared to the more structured user experience at Howard Lake or the Libby Creek Recreational Gold Panning Area. The KNF has management responsibility for recreational uses of these lands.

KNF uses the ROS inventory as a tool for defining classes of outdoor recreation opportunity environments, making management decisions, and as a way to communicate recreation priorities with the public (USDA Forest Service 1982). ROS classifies recreational opportunities into six categories: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Natural, Roaded Modified, and Rural (Table 115) (USDA Forest Service 1990).

The Forest Service currently classifies the Poorman Creek and Ramsey Creek drainages as Semi-Primitive Motorized, while the Libby Creek drainage and the major access corridors are classified as Roaded Natural. Most of the remaining areas outside of CMW are Semi-Primitive Non-Motorized.

3.15.3.1.1 Hunting

In Montana, 24 percent of residents hunt, the highest level of participation in the nation (FWP 2005). Every fall, hunters frequent the hunting districts close to Libby. The FWP conducts an annual statewide harvest survey to determine hunter activity throughout the state. Data for hunter activity in the analysis area are summarized in Table 116. The Libby Ranger District has 14 permitted outfitters with five operating in the south end of the district. Three outfitters and guides (permitted for service days by both the Cabinet and Libby Ranger Districts) operate in an area near the proposed mining project (Jeresek, pers. comm. 2006a).

Table 115. ROS Characteristics.

ROS Category	Description
Primitive	Characterized by essentially unmodified natural environment of fairly large size. Interaction between users is fairly low and evidence of other users is minimal. Motorized use is not permitted.
Semi-Primitive Non-Motorized	Characterized by predominantly natuarl or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. Motorized use is not permitted.
Semi-Primitive Motorized	Characterized by predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. Motorized use is permitted.
Roaded Natural	Characterized by predominantly natural appearing environment with moderate evidence of human sights/sounds. Interaction between users is may be low to moderate, with evidence of other users prevalent. Conventional motorized use is provided for in the construction and design of facilities.
Roaded Modified	Characterized by modified natural environment with moderate to high evidence of human sights/sounds. Interaction between users is moderate to high, with evidence of other users prevalent. Conventional motorized use is provided for in the construction and design of facilities.
Rural	Characterized by substantially modified natural environment. Resource modification and utilization practices are primarily to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of man are readily evident, and the interaction between users is often moderate to high. Facilities for intensified motorized use and parking are available.

Source: KFP, USDA Forest Service 1987.

Table 116. Analysis Area Hunter Activity by Hunting District.

Hunting District	Location	Species	Year	Hunters	Hunter Days
104	West of U.S. 2	Black Bear	2002	655	4,967
105	West of U.S. 2	Black Bear	2002	943	7,499
103	East of U.S. 2	Elk	2006	2,178	16,648
104	West of U.S. 2	Elk	2006	1,339	10,763
100	West of U.S. 2 and East of Montana 58	Goat	2005	7	63
105	West of U.S. 2	Moose	2006	25	199
106	East of U.S. 2	Moose	2006	15	180
123	West of U.S. 2	Sheep	2005	5	35
103	East of U.S. 2	White-tailed and Mule Deer	2006	3,690	25,834
104	West of U.S. 2	White-tailed and Mule Deer	2006	2,210	16,705

Note: The analysis area generally includes only small portions of the much larger Hunting Districts. Hunter days are defined as the number of days or partial days spent hunting by active hunters.
Source: FWP 2007.

Hunting opportunities also are available on private lands as a result of FWP actions through the block management program and conservation easements. The block management program is a cooperative effort between FWP, landowners, and land management agencies to provide free public hunting access to private and isolated public land. Other lands with conservation easements generally offer some level of public hunting access. Hunting in the analysis area occurs on Plum Creek lands covered by a conservation easement, other private lands and also on state school trust land. Hunting on private land is subject to landowner discretion.

3.15.3.1.2 Fishing

Fishing opportunities within the analysis area occur primarily in easily accessible streams and rivers and at Howard Lake. Other lakes in the CMW, including Leigh Lake, Rock Lake, and Geiger Lake, provide additional fishing opportunities. Fishing is a relatively minor activity in Poorman Creek and West Fisher Creek. Most fishing in the analysis area occurs on the Fisher River and Howard Lake (FWP 2008d). The FWP does not track fishing use of Little Cherry Creek, Standard Creek, and Miller Creek because they provide a very small portion of the recreational fishing opportunity.

3.15.3.1.3 Scenic Driving

Scenic driving occurs along the forest roads within the analysis area. The most heavily used roads are the Libby Creek Road (NFS road #231), the Bear Creek Road (NFS road #278), and U.S. 2. Less traveled roads used for scenic driving connect with these primary roads.

3.15.3.1.4 Camping and Picnicking

Howard Lake Campground is the only fee campground within the analysis area. This campground offers swimming, fishing, hiking, boating, a water well, RV sites, and toilets. A maintained trail provides access to dispersed camping on one side of the lake. Easy access to Libby Creek and Libby Lakes trailhead facilitates other recreational opportunities in the area. Average annual use

by campers paying the fee for Howard Lake Campground during the 2002 to 2004 seasons was 185 campsites (556 campers). Recreationists engaged in day use activities dominate Howard Lake Campground. Recreation visits to Howard Lake are about 3,000 annually (Power Engineers 2005c).

3.15.3.1.5 Forest Product Gathering

Firewood gathering, Christmas tree cutting, and huckleberry and mushroom picking occur in the analysis area. Firewood is collected primarily in the spring and fall, but because of the large number of wood-burning stoves in the area, firewood collection is constant. The Forest Service considers huckleberry picking to be an important recreational use of the area, although no information is available concerning the number of individuals who visit the area for this purpose, or the economic values that may result (Jeresek, pers. comm. 2006b). Huckleberry season (late summer through early fall) brings many people to the area to take part in the berry harvest. The Forest Service estimates that about 80 percent of the pickers are local residents (Jeresek, pers. comm. 2006b).

3.15.3.1.6 Gold Panning

The Libby Creek Recreational Gold Panning Area offers the general public the opportunity to pan for gold in a historical area of placer mining. The area has no developed parking lots or camping facilities. Camping at the area is primitive with dispersed sites.

3.15.3.1.7 Winter Activities

Winter activities include ice fishing, cross-country skiing, and snowmobiling. Winter activities in the analysis area are the most common near Bear Creek and Poorman Creek, which provide good areas for skiing and snowmobiling. Bear Creek Road is plowed all winter by Lincoln County to about 1 mile north of Bear Creek, providing skiing and snowmobiling access to Bear Creek and Poorman Creek areas. Libby Creek Road is currently plowed by Lincoln County to Crazyman Road (NFS road #6209), about 1 mile south of U.S. 2. Some winter activities occur on the unplowed portion of Libby Creek Road. Ice fishing occurs on Howard Lake.

3.15.3.1.8 Trails

Several trails access the CMW within the east side of the analysis area (Bear Creek south to West Fisher Creek) (Figure 79). These trails are: Trail 119 Libby Creek, Trail 820 Ramsey Creek, Trail 129 Poorman Creek, Trail 821 Cable Creek, Trail 116 Standard Creek, and Trail 117 Great Northern Mountain. Other trails near the transmission line alternatives include Trail 716 Libby Divide, Trail 118 Miller Creek, Trail 6S Divide 6 Trail, and Trail 859 Kenelty Caves Trail. Some of these designated trails are located on roads that are closed to motorized use. The road portions of these trails have been managed as trails since 1981, unless administrative use has required a higher level of access (Power Engineers 2005c). Other trails within or in proximity to the analysis area are shown in Figure 79.

The Libby Ranger District has two types of trailheads—managed and unmanaged. The Leigh Lake trailhead is the only managed trailhead in the analysis area. The trail is accessible from May 1 to September 30. Between 2001-2003, the average number of annual visitors at Leigh Lake was 2,827 and the average number of visitor days (equivalent to one person using the resource for 12 hours) was 3,485 (Power Engineers 2005c). Data was not available for non-managed trails. These trails are generally lightly used, with most of the activity occurring in the summer and fall.

Seasonal use data for managed trailheads and unmanaged trailheads indicate a gradual increase in wilderness use since 1988. Seasonal use data reflect high use during the summer (about 85 percent of total), moderate use during the fall (about 10 percent), and light use during the winter (about 5 percent) (MMI 2005a).

3.15.4 Environmental Consequences

The road closures described below would restrict both summer and winter recreation access for a variety of recreational uses, including hiking, hunting, fishing, OHV use, snowmobiling, cross-country skiing, berry picking, dispersed camping, and other uses in the affected areas. Secondary effects to recreation activities on lands adjacent to mine facilities would occur from mine- and construction-related noise and disturbance.

3.15.4.1 Alternative 1 – No Mine

Alternative 1 would have no impact upon recreation in the analysis area. Access to roads and trails would continue as in the past. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Visitors to the area may experience increased noise levels from activities at the Libby Adit Site. These effects would be temporary and there would be no long-term effects to visitors' recreational experiences if no mine were constructed.

3.15.4.2 Alternative 2 – MMC's Proposed Mine

3.15.4.2.1 Short-term Effects During Construction, Operations, and Reclamation Phases

In general, recreational use and access to the analysis area would continue, although the configuration of some access roads would change slightly and the overall character of recreation opportunities within or adjacent to mine facilities would change substantially. Short-term effects during mine construction, operation, and reclamation would include restricted public access, increased noise, and increased night lighting within and adjacent to the mine facility areas. Public motorized and non-motorized access would be restricted to mine and agency personnel in all permit areas. These effects would reduce the amount of area available for hunting and other dispersed recreation activities.

The proposed mine and associated facilities in Alternative 2 would reduce public recreational access due to road closures. Public motorized and non-motorized access would be restricted to mine and agency personnel in all permit areas. Specific road closures would include the Little Cherry Loop Road (NFS road #6212) within the proposed Little Cherry Creek Tailings Impoundment Site, the Poorman Creek Road (NFS road #2317) in the lower portion of the Poorman Creek drainage, and NFS road #4784 in the Bear Creek drainage (which is already proposed for an access change as part of the Rock Creek Project mitigation).

Prior to mine operation, Libby Creek Road (NFS road #231) and Upper Libby Creek Road NFS road #2316 would be plowed in the winter as part of a 2-year Libby Adit evaluation program and a 1-year Bear Creek Road (NFS road #278) reconstruction. The improvements to the Bear Creek Road would improve recreational access to the area, although the section of road that would not be improved could be unsafe for users. Because the Bear Creek Road would be plowed in the

winter, it would improve winter recreation access to the analysis area. Similarly, the Libby Creek Road would be plowed for 2 to 3 years during construction, improving winter recreation access to areas off of the road. Snowmobile and cross country skiing use of the Libby Creek Road and parts of Upper Libby Creek Road during construction, and of the Bear Creek Road during mine life would be eliminated.

Access restrictions at the permit area boundary of each mine facility would eliminate access to all roads within the permit boundary that are currently closed to motorized use but open to non-motorized use. These closures would eliminate non-motorized access to the Poorman Creek and Ramsey Creek drainages (NFS road #2317 and NFS road #4781, respectively). Similarly, non-motorized access to existing trails in the Poorman Creek (Trail 129) and Ramsey Creek (Trail 820) would be lost. Non-motorized trail access up the Libby Creek drainage (Trail 119) would not be affected.

The overall character of the trail user experience would be altered in the Libby Creek drainage due to noise, traffic, and visual effects associated with the proposed facilities. Within the CMW and the adjacent Cabinet Face East IRA, the recreational enjoyment of trails, lakes, and overall wilderness values in the upper Ramsey Creek drainage may be adversely affected due to the construction, operation, and reclamation of the Ramsey Plant Site (see also sections 3.19, *Sound, Electrical and Magnetic Fields, Radio and TV Effects* and 3.23, *Wilderness and Inventoried Roadless Areas*). Visual effects to user experience due to the construction and operation of proposed facilities are described in section 3.16, *Scenery*. The proposed Rock Lake Ventilation Adit, located east of Rock Lake on a small parcel of private land within the CMW, would potentially be visible from some locations within the CMW. The surface features at the ventilation shaft and the overall effect of those features would be minimal and would not affect recreation.

The Howard Lake Campground and the Libby Creek Recreational Gold Panning Area would not be directly affected by any of the proposed facilities or road closures, but may be subject to increased use due to better road access and familiarity among mine employees in the area. The combination of mine development and improved recreational access may displace some dispersed recreation activities (such as hunting, hiking, and dispersed camping). Individuals who are currently accustomed to these areas may move on to other areas of the forest with fewer visitors and developed facilities.

In Alternative 2, Little Cherry Creek would be diverted in a permanent Diversion Channel around the impoundment. Most of the diversion would be within the operating permit area for the tailings impoundment, and access would be restricted. In the 1993 KNF ROD on the Montanore Project, the KNF and FWP agreed that the “limited access to the affected length of Little Cherry Creek warrants a loss estimate of 383 angler-hours of recreational potential regardless of existing use levels” (USDA Forest Service 1993). The fisheries mitigation proposed by MMC in Alternative 2 was identified as adequate mitigation for the loss of recreational opportunity in the KNF’s 1993 ROD.

3.15.4.2.2 Changes to Recreation Setting

During mine operations, the level of mine facility development proposed in Alternative 2 would change the ROS characteristics for some portions of the analysis area. The Ramsey Creek drainage within the analysis area would change from Semi-Primitive Motorized to Rural in character, while the Libby Creek drainage through the analysis area would change from Roaded

Natural to Rural. As in all action alternatives, the Bear Creek Road (NFS road #278) corridor would remain Roaded Natural from U.S. 2 to the impoundment site, and would change to Rural near the impoundment site, LAD Areas, and plant site. These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. The Libby Creek Road (NFS road #231) would remain as Roaded Natural. Estimated changes to ROS characteristics within the analysis area, in acres, are shown in Table 117.

Table 117. Change in Acres of ROS Characteristics within the Analysis Area, Mine Alternatives.

ROS Category	Alternative 1 – No Mine (Existing Conditions)	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment Alternative	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative
Primitive	67	67 (0)	67 (0)	67 (0)
Semi-Primitive Non-Motorized	4,821	3,377 (-1,704)	3,703 (-1,118)	3,730 (-1,091)
Semi-Primitive Motorized	534	108 (-426)	487 (-47)	488 (-46)
Roaded Natural	5,685	3,748 (-1,936)	4,058 (-1,627)	3,684 (-2,000)
Roaded Modified	2,130	1,694 (-436)	1,745 (-385)	1,645 (-485)
Rural	0	4,502 (+4,502)	3,176 (+3,176)	3,623 (+3,623)

(#) change from existing conditions due to the alternative.
Total analysis area is 13,236 acres.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.15.4.2.3 Long-term Effects After Closure

The long-term effects to recreation after completion of mine operations and reclamation include the elimination or closure of several roads within the permit boundary. Motorized access to the Little Cherry Creek Loop road (NFS road #6212) within the Little Cherry Creek Tailings Impoundment Site would change due to the tailings impoundment, reducing motorized access for scenic driving, hunting, fishing, and other uses.

Over the long term, public access would be restored to portions of NFS road #5182 through the Little Cherry Creek Tailings Impoundment Site and NFS road #4781 through LAD Area 2. The restoration of access along NFS road #4781 would provide long-term motorized access to the Poorman Creek drainage (NFS road #2317/Trail 129) and both motorized and non-motorized access to the Ramsey Creek drainage (motorized access along NFS road #4781 and non-motorized access to Trail 820).

No long-term effects to trail user access or experiences in the CMW, the Howard Lake Campground, and the Libby Creek Recreational Gold Panning Area would occur. With the exception of the tailings impoundment area, the long-term ROS characteristics throughout the analysis area would return to preexisting categories as disturbed areas become successfully revegetated and tree cover returns to pre-mine conditions. The tailings impoundment would remain a large, man-made structure and the ROS characteristics would not return to pre-mine conditions. The increased access and familiarity of the area for recreation would likely result in long-term displacement of dispersed users in and around the analysis area.

3.15.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.15.4.3.1 Short-term Effects During Construction, Operations, and Reclamation Phases

The overall short-term effects of Alternative 3 on recreation would be similar to Alternative 2, except as discussed below. Public motorized and non-motorized access would be restricted to mine and agency personnel in all permit areas.

Noise from the Libby Plant Site may adversely affect recreational use and enjoyment of the Libby Creek Recreational Gold Panning Area (see section 3.19.4, *Environmental Consequences* of the *Sound, Electrical and Magnetic Fields, Radio and TV Effects* section). Visual effects to user experience due to the construction and operation of proposed facilities are described in section 3.16.4, *Environmental Consequences* of the *Scenery* section.

The specific configuration of the Little Cherry Loop Road (NFS road #6212) closure and other road closures within the proposed Poorman Tailings Impoundment Site would be different from Alternative 2, but the effect of the closures (restricting both motorized and non-motorized recreation access) would be the same.

Non-motorized recreation and trail access to the upper Poorman Creek drainage (NFS road #2317/Trail 129) would be retained and improved due to the development of a recreational parking area adjacent to LAD Area 1 along Poorman Creek Road (NFS road #2317). The recreational enjoyment of the Libby Creek Trail (Trail 119), west of the Libby Adit Site, and overall wilderness values in the CMW would be altered in the upper Libby Creek drainage due to noise, traffic, and visual effects associated with the proposed facilities in the Libby Creek drainage. Unlike Alternative 2, non-motorized recreation access would be permitted through the permit area boundary on NFS road #4781/Trail 820 to the upper Ramsey Creek drainage. The improvements to the Bear Creek Road (NFS road #278) would improve recreational access to the area. Because the Bear Creek Road would be plowed in the winter, it would improve winter recreation access to the analysis area (although the existing snowmobile use of the road would be affected).

The development of a scenic overlook along the Bear Creek Road (NFS road #231) east of Howard Lake with interpretive information about the mine would benefit recreation opportunities by providing an additional amenity in the area. Overall recreation effects would be mitigated through funding a campground host from Memorial Day through Labor Day at Howard Lake Campground during the construction and operation phases of the mine.

Channels affected by the Poorman Tailings Impoundment Site are not fish-bearing and do not provide recreational fishing access. Alternative 3 would not affect recreational fishing opportunities.

3.15.4.3.2 Changes to Recreation Setting

The level of mine facility development proposed in Alternative 3 would change the ROS characteristics for the analysis area. The Libby Creek drainage within the analysis area would change in character from Roaded Natural to Rural. As in all action alternatives, the NFS road #278 corridor from U.S. 2 to the impoundment site, and would change to Rural near the impoundment site, LAD Areas, and plant site. These changes from less developed to more developed recreation settings probably would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Estimated changes to ROS characteristics within the analysis area, in acres, are shown in Table 117.

3.15.4.3.3 Long-term Effects After Closure

The long-term effects of the mine operations, after closure and reclamation are complete, would include the elimination of several roads within the tailings impoundment site, including NFS road #6212.

Long-term recreational access to the roads and trails in the Poorman, Ramsey, and Libby Creek drainages would be similar to existing conditions. Roads and trails closed for wildlife mitigation would no longer be used for motorized access. No long-term effects to trail user access or experiences in the CMW, the Howard Lake Campground, and the Libby Creek Recreational Gold Panning Area would occur. The long-term effect on ROS characteristics would be the same as Alternative 2. New recreation amenities, including a recreational parking area along Poorman Creek Road (NFS road #2317) and a scenic overlook along Bear Creek Road (NFS road #231) would result in long-term recreation benefits.

3.15.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The effects of the plant site, adits, and LAD Areas in Alternative 4 on recreation and recreation setting would be the same as those described under Alternative 3. The effects of the tailings impoundment in Alternative 4 on recreation would be the same as those described under Alternative 2. The long-term effect on ROS characteristics would be the same as Alternative 2. Proposed mitigation (campground enhancement) would be the same as Alternative 3.

3.15.4.5 Alternative A – No Transmission Line

Alternative A would not affect recreation in the analysis area. Access to roads and trails would continue as it is currently. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.15.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The North Miller Creek Alternative would result in the greatest amount of new access roads (9.9 miles) for the construction and maintenance of the transmission lines (Table 113). These roads would be closed to motorized vehicles. These new roads would benefit non-motorized recreation access (*i.e.*, walk-in hunting and fishing access, hiking, berry picking) on both National Forest System lands and on private lands where public access was permitted.

Alternative B would cross through the Libby Creek Recreational Gold Panning Area for a distance of 1,761 feet, and also would cross Trails 118, 716, and 820 (Figure 79). Transmission line construction would adversely affect the short-term use and enjoyment of these areas due to increased noise, traffic, and construction activity. During mine operation, the existence of the transmission line would alter the scenic integrity and landscape character of trail corridors and the Gold Panning Area. This alteration of scenic integrity and landscape character in these localized areas could result in minor adverse effects on enjoyment of recreational amenities that are crossed by transmission lines.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area north of Miller Creek (Table 118). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time when the transmission lines are decommissioned. As vegetation cover fills in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.15.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would benefit non-motorized recreation access by providing 3 miles of new access roads on both National Forest System and private lands where public access is permitted (Table 113). These new road corridors would enhance non-motorized recreation access. The length of new roads in Alternative C (and subsequent recreation benefits) would be the least among the transmission line alternatives. Alternative C would cross trails 859, 118, 716, and 820 (Figure 79), as well as the Libby Creek Recreational Gold Panning Area for a distance of 1,754 feet. The adverse effects to trails and the Gold Panning Area would be the same as Alternative B.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area north of Miller Creek (Table 118). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time when the transmission lines are decommissioned. As vegetation cover fills in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.15.4.8 Alternative D – Miller Creek Transmission Line Alternative

Alternative D would result in slightly more miles (3.3 miles) of new access roads (and related benefits to non-motorized recreation access) than Alternative C. Alternative D would cross trails 859, 300, and 820 (Figure 79), as well as the Libby Creek Recreational Gold Panning Area for a distance of 2,118 feet. The effects to trails and the Gold Panning Area would be the same as Alternative B. As described in section 3.16, *Scenery*, visual effects to recreationists at Howard Lake would be negligible.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area adjacent to upper Miller Creek (Table 118). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time

when the transmission lines are decommissioned. As vegetation cover fills in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.15.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

The length of new access roads in Alternative E (and related benefits to non-motorized recreation access) (3.5 miles) would be greater than Alternatives C and D, but less than Alternative B. Alternative E would cross trails 859 and 820 (Figure 79), as well as the Libby Creek Recreational Gold Panning Area for a distance of 2,118 feet. The effects to trails and the Gold Panning Area would be the same as Alternative B. As described in section 3.16, *Scenery*, visual effects to recreationists at Howard Lake would be negligible. These changes are not anticipated to substantially affect the ROS characteristics (Table 118).

Table 118. Change in Acres of ROS Characteristics within the Analysis Area, Transmission Line Alternatives.

ROS Category	Alternative A – No Trans-mission Line, No Mine (Existing Conditions)	Alternative B – MMC's Proposed Trans-mission Line (North Miller Creek Alternative)	Alternative C – Modified North Miller Creek Trans-mission Line Alternative	Alternative D – Miller Creek Trans-mission Line Alternative	Alternative E – West Fisher Creek Trans-mission Line Alternative
Primitive	0	0 (0)	0 (0)	0 (0)	0 (0)
Semi-Primitive Non-Motorized	4,597	3,066 (-1,531)	3,522 (-1,075)	4,053 (-544)	4,463 (-134)
Semi-Primitive Motorized	1,063	2,593 (+1,531)	2,054 (+991)	1,509 (+447)	1,099 (+36)
Roaded Natural	4,322	4,322 (0)	4,406 (+84)	4,420 +(97)	4,420 +97)
Roaded Modified	4,029	4,029 (0)	4,029 (0)	4,029 (0)	4,029 (0)
Rural	0	0 (0)	0 (0)	0 (0)	0 (0)

Changes from existing conditions are shown in (parentheses).
Total study area is 14,011 acres.
ROS = Recreation Opportunity Spectrum
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.15.4.10 Cumulative Effects

Past actions within the analysis area include the establishment of forest access roads and logging roads and the development of the Howard Lake Campground and Libby Creek Recreation Gold Panning Area. These past actions have resulted in the existing recreation setting described above under section 3.16.3, *Affected Environment*. When considering reasonably foreseeable future actions, the development of the Rock Creek Project likely would have similar effects on recreation access and trails within the CMW as those proposed for the Montanore Project. The increased traffic and noise from both mining operations would diminish the quality of some

recreational experiences within the CMW, primarily near Elephant Peak, Rock Peak, and their associated ridgeline. The proposed Snowshoe Project, which would remove tailings from the Snowshoe Mine Site to the north of the analysis area, could exacerbate these effects to recreation experiences within the CMW. Population increases due to these projects would slightly increase demand for recreational opportunities in the region. Even with this increased demand, an abundance of outdoor recreational opportunities would remain for residents and visitors.

3.15.4.11 Regulatory/Forest Plan Consistency

All of the proposed mine and transmission line alternatives would be consistent with the recreation standards in the KFP. This analysis complies with Executive Order 12962 that mandates disclosure of effects to recreational fishing.

3.15.4.12 Irreversible and Irretrievable Commitments

The recreational experience of some users may be irretrievably affected by the project, due to loss of access to particular areas, increased noise, or visual impacts. These effects, combined with increased knowledge of and access to the general analysis area, would likely displace some dispersed recreation (hunting, hiking, and dispersed camping) to other areas of the forest. Long-term road closures within the tailings impoundment and other areas for grizzly bear mitigation (in Alternative 2) would result in an irretrievable loss of recreational access to those roads. The long-term effect on ROS characteristics at the tailings impoundment site would be irreversible.

3.15.4.13 Short-term Uses and Long-term Productivity

All of the action alternatives would include both short-term and long-term road closures within the permit boundary. Short-term closures would have the greatest effect on recreation access in Alternative 2, which would restrict access to the Ramsey and Poorman creek drainages. Long-term road closures in all of the action alternatives would result in a loss of recreation access to NFS road #6212 and several other spur roads within and adjacent to the tailings impoundment. The long-term effects of the proposed project on recreation access in the analysis area would be small.

The noise and visual effects of the proposed project would be most noticeable during the 16 to 19 years of operations. Noise would return to pre-mine levels when reclamation activities ceased, while visual effects would be reduced over time as revegetation efforts were completed and the forest cover re-established in disturbed areas. Over the long term, the proposed project would not affect the ability of the analysis area to provide a variety of forest recreation opportunities.

3.15.4.14 Unavoidable Adverse Environmental Effects

Alternatives 2, 3, and 4 would restrict access and recreational use along the Little Cherry Creek Loop Road (NFS road #6212), which would be restricted to public motorized and non-motorized access. Alternative 2 would restrict recreational access to the Ramsey Creek and Poorman Creek drainages. In addition, all of the proposed transmission line alternatives would alter the scenic integrity of the Libby Creek Recreational Gold Panning Area, as well as several trail corridors. The proposed mine alternatives would adversely affect some recreational experiences due to noise and visual impacts. These aesthetic impacts would be concentrated in the Ramsey and Libby creek drainages in Alternative 2, the Libby Creek drainage in Alternatives 3 and 4, and along NFS road #278 (Tailings Impoundment Sites) in all mine alternatives. The long-term effect on ROS characteristics at the tailings impoundment site would be unavoidable.

3.16 Scenery

3.16.1 Regulatory Framework

Requirements for environmental protection for operations involving locatable minerals are described in the Forest Services' mineral regulations (36 CFR 228, Subpart A). All operations are required, to the extent practicable, to harmonize operations with scenic values through such measures as the design and location of operating facilities, including roads and other means of access, vegetative screening of operations, and construction of structures and improvements which blend with the landscape (36 CFR 228.8(d)).

Under the current KFP, the KNF uses the USDA Forest Service Visual Management System (VMS) to inventory visual resources and to provide measurable scenery management standards on the KNF (USDA Forest Service 1974). VQOs were determined by the KNF for the entire KNF following an analysis of characteristic landscapes and sensitivity levels. The five VQOs are: Preservation, Retention, Partial Retention, Modification, and Maximum Modification; these terms are defined in the *Glossary*. Development of measurable standards or objectives for the visual management is the purpose of assigning VQOs. Each VQO describes a degree of acceptable alteration of a characteristic landscape based on the importance of aesthetic resources to the users. VQOs are an important part of the KFP because many national forest users and nearby residents value the forest's intrinsic aesthetic resources.

In mine Alternatives 2, 3, and 4, the KNF would amend the KFP by reallocating to MA 31 all areas within the operating permit areas of LAD Areas 1 and 2, and portions of the plant site and tailings impoundment currently not in MA 31. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. In addition, a proposed road and facility corridor that would cross MA 13 would be reallocated to MA 31. MA 31 has a VQO of Maximum Modification. Therefore, the applicable VQO for all mine facilities would be Maximum Modification. In transmission line Alternatives B, C, D, and E, the KNF would amend the KFP by reallocating certain areas disturbed by the 230-kV transmission line on National Forest System lands as MA 23. MA 23 has a VQO of Maximum Modification. The MAs that would not be reallocated to MA 23 currently have a VQO of Modification. The applicable VQO for all transmission line alternatives would be Maximum Modification or Modification.

3.16.2 Analysis Area and Methods

3.16.2.1 Analysis Area

The analysis area was determined by the location of the proposed mine facilities, the location of four transmission line alternatives and the visible portions of proposed project facilities that would affect the characteristic landscapes and sensitivity levels of observation points used in visual baseline reports. Changes to characteristic landscapes would include loss of vegetation and landform modifications at and near the proposed facilities, and sensitivity levels would be lowered by the presence of mine facilities not already existing within a given view. Scenery in the analysis area includes the summit and shoulder terrain of the Cabinet Mountains, forested mountains, and valleys adjacent to and east of the Cabinet Mountains; and a 6-mile portion of U.S. 2 east of the Cabinet Mountains (Figure 80).

3.16.2.2 Methods

Several previous visual resource reports and additional analysis were used to describe and assess effects on scenery. A visual baseline report that characterized the visual resources near proposed mine facilities, excluding any transmission line alternatives, was prepared in 2005 (Maxim Technologies 2005). The report assessed the visual effects of the mine facilities using two USDA Forest Service methods for analysis. Both methods were acceptable to the KNF and DEQ, and used KNF user data and observation points from a previous visual resource baseline study (Woodward-Clyde Consultants 1989d). The agencies determined the data to be applicable to most of the current physical conditions and user preferences.

Another report characterized the visual resources and assessed visual impacts of three transmission line alternatives evaluated by MMC (Power Engineers, Inc. 2006b). The report used the same two methods as the Maxim Technologies report to analyze visual impacts.

The current mine and transmission line alternatives were assessed from 11 key observation points (KOP) selected by the KNF and DEQ (Holdeman Landscape Architecture 2006). An alpine characteristic landscape located above timberline in the Cabinet Mountains on Elephant Peak is one of the KOPs. The USDA Forest Service VMS method was used to describe impacts to scenery for the alternatives. The VMS method of analysis directly associated project impacts to applicable VQOs.

Visual analysis of the transmission line alternatives consisted of two viewshed analyses. One viewshed analysis was performed from each of the 11 KOPs. Vegetation was included in the analysis by adding an average tree height to the digital terrain model to accurately determine the length of each transmission line alternative visible from each KOP. Different tree heights were assumed for timber and non-timber harvested areas. Digital polygons were developed to represent the shape of the tree clearing areas required for the lines, structures, and access roads. The digital polygons were “elevated” electronically above the ground to the average tree height. The total length of transmission line alternative visible from each KOP was calculated using GIS. A qualitative analysis is also provided in the EIS regarding the level and type of use of each KOP. The qualitative analysis was developed from field observations and photographic simulations from four of the 11 KOPs (Figure 80).

The second viewshed analysis was performed from the corridor of each transmission line alternative. The same polygons used in the first analysis were used in the second one. This analysis determined the number of KOPs, length of high-use roads, and acres of CMW visible from each transmission line corridor. Roads used in the analysis were NFS roads #4776, #4724, #231, #385, and U.S. 2.

The visibility of the transmission line from the Howard Lake Campground was evaluated in two transmission line alternatives, Miller Creek and West Fisher Creek. These two alternatives would use the same alignment east of the lake and campground. Using digital elevation data, a profile of the ground surface was developed for each transmission line structure near the lake. Trees 75 feet high between the viewer on the west side of the lake and the transmission line were used to determine line visibility. The analysis is on file in the project record.

3.16.3 Affected Environment

The analysis area is characterized visually by the summit peaks of the Cabinet Mountains surrounded by the adjacent densely forested mountains and valleys, with some flat, open creek or stream valleys of dense low-growing herbaceous vegetation interspersed with the forest. The four transmission line alternatives and mine facilities alternatives would be located in montane forest and valley characteristic landscapes within the KNF. Multiple alpine peaks in the Cabinet Mountains are also a significant part of views from most of the key observation points.

3.16.3.1 Characteristic Landscapes

An area's visual character, called characteristic landscape, is based on the area's physical characteristics, such as viewing distance, landform variety, and the presence of man-made forms. Three characteristic landscapes are found in the analysis area: alpine, montane forest, and montane valley. These landscapes are described in the following sections.

3.16.3.1.1 Alpine Characteristic Landscape

The alpine characteristic landscape is defined by a portion of the Cabinet Mountains along a north-south line from Snowshoe Peak to Baree Mountain (about 35 miles long and 7 miles wide), centered along the range's highest peaks; and includes some mountainous areas below timberline known as the Cabinet Shoulders. Mountain summit landforms with dominant vertical and steep slopes above timberline typify the alpine characteristic landscape. Near mountaintops and above timberline, areas of snow are frequently present. The summit topography possesses strong contrasting characteristics with the sky and landforms below.

The mountain slopes below and near timberline support sparse populations of evergreen trees with a ground cover of shrubs and grasses. The forested portion of the alpine characteristic landscape also includes large, mostly bare rock formations, creating many open areas among the trees. This region has the highest elevations (8,738 feet at Snowshoe Peak) in the analysis area.

Although no mine facilities or transmission line alternatives would be located in the alpine characteristic landscape, one KOP is located in this area. Additionally, this characteristic landscape is an important component of the views from most of the other KOPs. This characteristic landscape is the highest quality scenery as defined by the VMS.

The KOP in the alpine characteristic landscape is located on Elephant Peak in the CMW. Views from this location are unobstructed in nearly all directions; are mostly absent of artificial forms; and include a large variety of landforms, rock forms, water forms, colors, and textures. The views from this KOP are representative of most of the Cabinet Mountains peaks and some of the CMW above timberline. Most of the proposed mine facilities, not including the tailings impoundments, and portions of all four transmission line alternatives would be visible from this KOP.

3.16.3.1.2 Montane Forest Characteristic Landscape

Most mine and transmission line alternatives would be located in the montane forest characteristic landscape. Densely forested mountain landforms typify this landscape. Due to the high density and the height of the forest near roads, only a small number of long-distance views exist from roads. Most views along roads are of the forest and restricted to short distances.

The analysis area has few developed recreational facilities; most observation points are from roads, mountains, and hill tops, or at the edge of the forest. An exception is the developed

campground area at Howard Lake, which has a KOP located on the beach next to the lake. Timber harvest areas have created some openings in the forest along roads that provide views of the Cabinet Mountain summits and valleys below. These few locations offer tree-framed views with a large variety of mountainous landforms, vegetation communities, and sky conditions. KOPs 1, 2, 4, and 6 are located in montane forests.

3.16.3.1.3 Montane Valley Characteristic Landscape

Gentle to nearly flat landforms with creeks or streams define the montane valley characteristic landscape, which is interspersed within the montane forest characteristic landscape. Some mine facilities and transmission line alternatives would be located in the montane valley characteristic landscape. Montane valleys include forested areas similar to the adjacent mountains and openings with low-growing herbaceous vegetation and deciduous shrubs and trees concentrated along creeks. Views of the Cabinet Mountain summits are visible from the valleys with low-growing vegetation. Valley areas also include the only buildings visible from KOPs in the analysis area. All of the buildings are residences or associated outbuildings, and most of the residences are located along U.S. 2. Due to the relatively small quantity, very low density, and partial obscurity by low density vegetation, these structures rarely distract from scenic views by travelers and other recreationists.

Some timber harvest areas of the KNF and adjacent private lands are visible from KOPs located in montane valleys. A few timber harvest areas are immediately adjacent to the public roads and are therefore highly visible. Timber harvest areas on mountainsides are typically only partially visible due to the screening effects of vegetation and topography. KOPs 7, 8, 9, 10, and 11 are located in montane valleys.

3.16.3.2 Visual Quality Objectives

Areas currently managed for Partial Retention VQO are located within portions of the analysis area for all proposed facilities. Areas managed for Modification VQO are also located within portions of the analysis area for all proposed facilities. To meet the Modification VQO, management activities may visually dominate the characteristic landscape. With a Modification VQO, activities of vegetation and/or landform alteration must borrow from the existing undisturbed form, line, color, and texture so as to match the surrounding characteristic landscape. Management activities may dominate the characteristic landscape in a Maximum Modification VQO.

3.16.3.3 Concern Levels

Concern levels, from low to high, were established from user survey information for individual observation points to determine the importance of visual resources to the visitors. Concern levels of visitors were identified from visitor use monitoring data collected by the KNF (Kocis *et al.* 2003). The largest groups of visitors to the KNF are local residents from the towns of Libby, Troy, and Eureka. Forest scenery consistently ranked highest in importance for wilderness, developed day use areas, overnight facility users, and some private residences with views of proposed facilities. Concern levels at private residences in the analysis area are high. Views from private residences are typically long-term and often influence specific uses of private properties.

3.16.4 Environmental Consequences

3.16.4.1 Alternative 1 – No Mine

The existing scenery from KOPs would not change in the No Mine Alternative. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The existing Libby Adit Site would remain, and would be visible only from KOP 4 in a montane forest at a NFS road #231 Pullout (Figure 80). Disturbances on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals.

3.16.4.2 Alternative 2 – MMC's Proposed Mine

For all action alternatives, and for the duration of the mine's and transmission line's operation, mine facilities, presence of haul vehicles, and introduction of night lighting at all mine facilities and along NFS roads would alter views from KOPs and other locations. Following mine closure, reclamation of most mine facilities would return disturbed areas to a condition similar to a timber harvested area. The tailings impoundment would not be restored to match any existing condition in the KNF and would result in a permanent change in scenery.

3.16.4.2.1 Libby Adit Site and Rock Lake Ventilation Adit

The Libby Adit Site would alter scenic integrity from the scenic overlook at KOP 2, Elephant Peak (KOP 3), the south NFS road #231 pullout (KOP 4), a portion of NFS roads #231 and #4776, portions of the CMW, and a portion of a private land parcel along Libby Creek northeast of the adit site. (Figure 80). Viewing significance, as defined by the VMS Concern Levels from the three KOPs and two roads would be high due to high visitor use, close proximity to the impoundment, long viewing duration due to stationary viewers or a high viewing angle above the site's location. The visible landscape character would be changed through landform modifications and vegetation pattern interruptions. The change would alter scenic integrity by introducing noticeable contrasts of new buildings, fencing, night lighting, and the presence of mine traffic. The visual absorption level of the Libby Adit Site is high, indicating a substantial capacity to accommodate change. Noticeable changes from KOP 4 would be substantial due to a direct unobstructed line of sight to the adit and long duration views. Only a relatively small portion of the adit site would be visible from the private land parcel due to the screening effects of trees and topography. The Libby Adit Site would meet Maximum Modification VQO criteria.

Following the mine closure, regrading and revegetation would create areas with similar landscape characteristics to the existing timber harvested areas and unpaved, abandoned roads. The adit site would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

The Rock Lake Ventilation Adit would be an air ventilation opening on the ground, about 15 feet by 15 feet in size, and covered by a metal grate. No mine materials would be transferred to or from this location, and a temporary construction disturbance of less than 1 acre would occur because the adit would be constructed from the mine underground. The adit would be located on the west side of the Cabinet Mountains and, therefore, not visible from 10 of the 11 KOPs. The adit would be very difficult to see from KOP 3, Elephant Peak, because of the site's relatively small size and the screening effects of topography. Views of the adit from Rock Lake would be

partially obscured by topography and timberline vegetation. Because the Rock Lake Ventilation Adit is located on private land, no VQO criteria apply. Following the mine closure, regrading would create an area with similar landscape characteristics to the existing treeless areas at timberline.

3.16.4.2.2 Ramsey Plant Site

Construction and use of the Ramsey Plant Site would alter the scenic integrity from the scenic overlook at KOP 2, Elephant Peak (KOP 3), a portion of NFS roads #231 and #4776C, and portions of the CMW (Figure 80). Viewing significance would be high due to high visitor use along NFS road #4776C and at KOP 2, and the high view angle above the plant site and unobstructed view from Elephant Peak (KOP 11). Although Elephant Peak is 1 mile from the plant site, it receives very low visitor use due to its remote location and non-motorized accessibility. Because the plant site and adit entrances would be located between two vegetated ridges to the north and south, views from the roads would be very short duration and partially obscured by vegetation; views from the CMW would be partially or entirely obstructed by topography and vegetation.

Landscape character would be changed over the short term due to the construction of the plant facilities, specifically to the vegetation pattern and land use. These changes would alter scenic integrity by introducing noticeable contrasts. The visual absorption capability of the plant site is high, indicating a substantial capacity to accommodate change, and the area of disturbance would be relatively small in most views.

Following the mine closure, regrading and revegetation would create areas with similar landscape characteristics to the existing timber harvested areas. The plant site would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

3.16.4.2.3 LAD Areas

Use of the two LAD Areas would alter the scenic integrity over the short term from the representative viewpoint along NFS road #4776C at KOP 2, the scenic overlook at KOP 3, a portion of NFS roads #231 and #4776, and portions of the CMW (Figure 80). Viewing significance from the two KOPs and two roads is high due to high visitor use and/or close proximity to the LAD Areas. Views from the KOPs are also long duration, while views from the two roads are short duration and partially obscured by vegetation. Viewing significance from the private land parcel east and south of the LAD Areas would be high due to potential long duration viewing times and close viewer proximity to the LAD Areas. The private land parcel north of Bear Creek would not be affected due to the screening effects of trees and topography.

The visible landscape character, such as the landform, vegetation pattern, and land use, would be changed over the short term due to the use of the LAD Areas. These changes would alter scenic integrity by introducing noticeable and significant contrasts. The visual absorption capability of the LAD Areas is high, indicating a substantial capacity to accommodate change. For example, tree clearings would have some similar landscape characteristics to the tree harvested areas in the same vicinity as the LAD Areas.

Following the mine closure, regrading and revegetation of the LAD Areas would potentially create areas with landscape characteristics identical to the existing timber harvested areas. The LAD Areas would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

3.16.4.2.4 Little Cherry Creek Tailings Impoundment Site

The Little Cherry Creek Tailings Impoundment Site would alter scenic integrity over the short term from KOPs 1, 2, and 3, a portion of NFS roads #231 and #4776, and portions of the CMW. Viewing significance from the three KOPs and two roads is high due to high visitor use, close proximity to the impoundment, long viewing duration, and a high viewing angle above the impoundment site. From KOP 2, the scenic overlook, approximately one-fourth of the impoundment site would be obstructed from view due to the screening effects of topography and vegetation. Although the visual absorption capability of the tailings impoundment location is moderate, its relatively large size in all views would create noticeable contrasts in landscape character, and significant alterations in scenic integrity. A visual simulation of the Little Cherry Creek Tailings Impoundment Site from KOP 2, a representative view from NFS road #4776C, is presented in Appendix I.

KOPs 1, 2, and 3, would have a mostly unobscured direct line of sight and view of a majority of the tailings impoundment. Because each KOP is a destination for scenic viewing, these views are also long in duration. KOPs 1 and 2 receive high visitor use. These two points are easily accessed by all vehicle types and are located relatively close to Libby and U.S. 2. Local residents often bring out-of-town visitors to these KOPs for scenic viewing.

Views of the tailings impoundment from NFS roads #231 and #4776 would be partially obscured by vegetation. Openings in the vegetation also would frame, and emphasize views of the tailings impoundment. Although these views would be mostly from slow-moving vehicles with short-viewing durations, the tailings impoundment would be visible from about 2 miles of NFS road #231, and about 1 mile of NFS road #4776. From NFS road #231 views of the tailings impoundment would be mostly perpendicular to the direction of travel, and from NFS road #4776 views would be directly in line with the direction of travel to the northwest. These two roads are the main vehicular access to KOPs 1 and 2.

Above timberline, dispersed recreational users in some areas of the CMW, would have unobstructed views of the entire tailings impoundment. Views from the CMW below timberline would be similar, but would be partially obscured by vegetation. The landform contrast and relatively large size of the tailings impoundment would create a noticeable interruption of scenic integrity from KOP 3, Elephant Peak, most locations in the CMW east of the major peaks ridgeline, and up to 6 miles away.

Scenic integrity and landscape character from the private land parcel southeast of the impoundment dam, about 0.5 mile (2,700 feet) between dam and nearest property line, would be permanently altered. Scenic integrity would be reduced in northwesterly views from the north end of the private parcel due to a view of the impoundment dam face partially obscured by trees and topography. Scenic integrity would be minimally reduced in northwesterly views from the southern portion of private land due to the increasing screening effects of the forest with increasing distance from the impoundment. The size of the impoundment also would be diminishing with increasing viewing distance.

Scenic integrity and landscape character from the private land parcel north of the impoundment site, about 0.25 mile (1,400 feet) between impoundment site and nearest property line, would not be affected, or affected only nominally. Visibility of the impoundment site, in southerly views only, would be mostly, or completely, obscured by topography and trees.

The visual absorption capability of the tailings impoundment location and surrounding vicinity is moderate, indicating a moderate capacity to accommodate noticeable change. For example, any disturbances of landform, major disruptions of vegetation patterns, or significant changes in land use at the impoundment site would be very noticeable. Following the mine closure, revegetation of the tailings impoundment would restore some color and texture characteristics similar to the adjacent undisturbed vegetation. Because of the large size and contrasting form, the tailings impoundment would remain an interruption of the scenic integrity of the site.

Following the mine closure in the future, revegetation of the tailings impoundment would partially reduce color and texture contrasts between the tailings impoundment and surrounding landscape. The tailings impoundment would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

3.16.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.16.4.3.1 Libby Creek and Rock Lake Adits

Effects on scenery at the Libby Adit Site would be slightly greater than Alternative 2 because of a larger area of contrasts created by the Upper Libby Adit and additional area of disturbance. Although the disturbed area would remain relatively small in the views from KOPs 2 and 3, the roads, and the CMW, the larger size of the contrasts would create a slightly greater visual distraction. Both adit sites would meet all Maximum Modification VQO criteria. Effects on scenic integrity and landscape character due to the Rock Lake Ventilation Adit would be the same as Alternative 2.

3.16.4.3.2 Libby Plant Site

Construction and use of the Libby Plant Site would alter the scenic integrity from KOPs 2, 3, and 4, a portion of NFS roads #231 and #4776C, portions of the CMW, and the private land parcel east of the plant site (Figure 80). The plant site would be located on a ridge between the Libby and Ramsey Creek valleys and would be highly visible. Viewing significance from KOP 2 is high due to high visitor use along NFS road #4776C, the high view angle above the plant site, and an unobstructed view of the entire plant site. Views from KOP 3 and Elephant Peak would have similar characteristics. Views from NFS roads #231 and #4776C would be short duration and partially obscured by vegetation. Views from CMW in the forest also would be partially obstructed by vegetation. Views from CMW above timberline would be completely unobstructed. Only a relatively small portion of the plant site would be visible from the private land parcel due to the screening effects of trees and topography.

The landscape character would change due to the construction of the plant facilities, specifically to the vegetation pattern, landform, and land use. These changes would alter scenic integrity by introducing noticeable contrasts. The visual absorption capability of the plant site is low, indicating a small capacity to accommodate change. Following the mine closure, regrading and revegetation would potentially create areas with similar landscape characteristics to the existing timber harvested areas. The plant site would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

3.16.4.3.3 LAD Areas

Effects on scenic integrity and landscape character due to the LAD Areas would be similar to Alternative 2. Use of the two LAD Areas would alter the scenic integrity from KOPs 2, 3, and 4, a portion of NFS roads #231 and #4776, portions of the CMW, and the private land parcel due

east of the LAD Areas (Figure 80). Effects and viewing significance from the KOPs, private land parcels, and two roads would be the same as Alternative 2.

Following the mine closure in the future, regrading and revegetation of the LAD Areas would create areas with identical landscape characteristics to the existing timber harvested areas. The LAD Areas would meet all criteria of the Maximum Modification VQO during construction, operations, and post-closure.

3.16.4.3.4 Poorman Tailings Impoundment Site

Effects on scenic integrity and landscape character due to the Poorman Tailings Impoundment Site would be similar to the Little Cherry Creek Tailings Impoundment Site in Alternatives 2 and 4. Because of the impoundment's location, the entire impoundment site would be visible from the scenic overlook at KOP 3. All other scenic integrity, landscape character, and visual absorption capability characteristics would be the same as Alternatives 2 and 4. The tailings impoundment site would meet all applicable Maximum Modification VQO criteria. A visual simulation of the Poorman Tailings Impoundment Site from KOP 2 is presented in Appendix I.

Scenic integrity and landscape character from the private land parcel due east of the impoundment dam, about 0.06 miles (350 feet) between dam and nearest property line, would be permanently and significantly altered. Scenic integrity would be substantially reduced in westerly views from the north end of the private parcel due to a mostly unobstructed view of the 270-foot high impoundment dam face. Scenic integrity would be moderately reduced in northwesterly views from the southern portion of this parcel due to the increasing screening effects of the forest with increasing distance from the impoundment. The size of the impoundment also would be diminishing with increasing viewing distance.

Scenic integrity and landscape character from the private land parcel north of the impoundment site, about 1.1 miles (5,700 feet) between impoundment site and nearest property line, would not be affected, or affected only nominally. Visibility of the impoundment site in southerly views only, would be mostly, or completely, obscured by topography and trees.

Following the mine closure in the future, revegetation of the tailings impoundment would partially reduce color and texture contrasts between the tailings impoundment and surrounding landscape. The tailings impoundment would meet all Maximum Modification VQO criteria during construction, operations, and post-closure.

3.16.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Effects on scenic integrity and landscape character due to the Libby Plant Site, Libby Adit Site, upper Libby Adit Site, Rock Lake Ventilation Adit, and LAD Areas would be the same as for Alternative 3. Effects on scenic integrity and landscape character due to the Little Cherry Creek Tailings Impoundment Site would be the same as for Alternative 2.

3.16.4.5 Alternative A – No Transmission Line

The analysis area's existing scenic integrity and landscape character as viewed from KOPs would not change in Alternative A. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit

evaluation program that do not affect National Forest System lands. The visual effect of the Libby Adit would remain until it was reclaimed in accordance with existing permits and approvals.

3.16.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The segments of the North Miller Creek Alternative visible from key viewing locations are shown on Figure 80. About 2.7 miles of transmission line would be visible from three of the 11 KOPs. All three KOPs with transmission line visibility (KOPs 8, 9, and 11) are located on private land. About 2.7 miles of transmission line would be visible from KOP 8, NFS road #385, and the private residences at KOP 11. Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from KOPs 8 and 9 due to the screening effects of topographic changes and trees. Effects to KOPs would be negligible because a relatively small portion of the tops of the transmission line structures would be visible slightly above evergreen treetops, and the visible tops would be a very small size within the views. Additionally, the tops of the structures would only be relatively small portions of views from the KOPs. This alternative would have the longest length of visible transmission line visible from the CMW, but the second lowest from high use roads (Table 120). This alternative would meet all Modification and Maximum Modification VQO criteria.

BPA's Sedlak Park Substation and loop line would be on private land owned by Plum Creek. It would not be subject to Forest Service visual management standards. The substation's perimeter would be illuminated during nighttime hours, and lighting would be directed downward to mitigate light and glare. No residences would have a direct view of the proposed substation location.

3.16.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

About 1.0 mile of transmission line would be visible from KOP 8, and less than 0.1 mile of transmission line would be visible from KOP 9. Both KOPs with transmission line visibility are located on private land (Figure 80). Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from both KOPs due to the screening effects of topographic changes and trees. Effects to KOPs would be the same as for Alternative B. This alternative would be visible from the fewest KOPs of all transmission line alternatives and the shortest length of high use roads (Table 120). This alternative would meet all Modification and Maximum Modification VQO criteria. The visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

3.16.4.8 Alternative D – Miller Creek Transmission Line Alternative

About 1.7 miles of transmission line would be visible from three of the 11 KOPs. Although 1.7 miles of transmission line would be visible from KOPs 5, 8, and 9, most of the visible portion of transmission line (Table 119) would be from KOP 8 and NFS road #385. Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from the three KOPs due to the screening effects of topographic changes and trees. KOP 5 is located in the KNF, and KOPs 8 and 9 are located on private land (Figure 80). Effects to KOPs would be the same as for Alternative B including KOP 5 at Howard Lake, because of the screening effects of the forest and topography, and the view angle of the transmission line away

from predominant views of the lake. The Miller Creek Alternative would be slightly more visible from high use roads than other transmission line alternatives (Table 120).

Effects to Howard Lake also would be negligible because only a small portion of the pole tops would be visible among the evergreen treetops in views to the northeast. The transmission line would not be visible to the southeast. Most visitors at Howard Lake would not have views of the transmission line clearing or structures. A visual simulation of the transmission line in Alternatives D and E from the west side of Howard Lake is presented in Appendix I. Visual simulations from other KOPs are available in the project record. This alternative would meet all Modification and Maximum Modification VQO criteria. The visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

3.16.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

About 0.9 mile of transmission line would be visible from KOPs 5, 7, and 8 (Table 119). Visibility of the transmission line, structures, and tree clearing area from these three KOPs would be very low and partially obscured due to the screening effects of topographic changes and trees. KOPs 5 and 7 are located in the KNF, and KOP 8 is located on private land (Figure 80). This alternative would affect views from the same number of KOPs as Alternative D. Effects to Howard Lake would be the same as Alternative D. This alternative would have the least total length of visible transmission line from the CMW (Table 120). It would meet all Modification and Maximum Modification VQO criteria. Similar to Alternative B, effects to KOPs would be negligible because a relatively small portion of the tops of the transmission line structures would be visible slightly above evergreen treetops, and the visible tops would be a very small size within the views. Additionally, the tops of the structures would only be relatively small portions within the views from the KOPs. Also, the visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

Table 119. Transmission Line Length Visible from KOPs.

KOP	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
1-4	—	—	—	—
5	—	—	0.3	0.3
6	—	—	—	—
7	—	—	—	0.3
8	1.6	1.0	1.4	0.2
9	0.2	<0.1	<0.1	—
10	—	—	—	—
11	0.9	—	—	—
Total	2.7	1.0	1.7	0.9

All units are miles.
— = Not visible from KOP.
KOP = Key Observation Point.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 120. Visibility of Transmission Line from KOPs, Roads, and the CMW.

Location	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
KOPs (number)	3	2	3	3
High use roads (miles)	12.5	11.6	13.4	12.9
CMW (acres)	1,501	1,426	1,233	1,177

KOP = key observation point.
CMW = Cabinet Mountains Wilderness.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Based on all KOP, road, and CMW locations with transmission line visibility, Alternative B would have the greatest length of high transmission line visibility at 3.29 miles, and Alternative C would have the greatest length of transmission line with no visibility at 3.43 miles (Table 121). Alternatives C, D, and E would have similar lengths of high and moderate visibility.

Table 121. Visibility Levels of Transmission Line Alternatives.

Visibility	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
No Visibility	1.90	3.43	2.01	1.84
Low	6.81	5.06	7.67	7.83
Moderate	4.35	3.44	3.40	3.45
High	3.29	1.48	1.04	1.77

All units are in miles.
Source: GIS analysis by ERO Resources Corp.

3.16.4.10 Cumulative Effects

Past actions of timber harvest and road construction have altered the scenic integrity of characteristic landscapes of the analysis area. Roads have created linear features visible throughout the analysis area. Timber harvests have altered the line, color, and texture of the undisturbed landscape. The future construction and operation activities of the Poker Hill Rock Quarry near NFS road #231 would affect the scenic integrity of views from the road. Both the quarry and planned mine facilities would be visible from NFS road #231. Timber harvest associated with the Miller-West Fisher Vegetation Management Project also would affect views from NFS roads #231 and #385.

3.16.4.11 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would meet all VQO criteria following the KFP amendment in each action alternative. There are no visual regulatory requirements for BPA's Sedlak Park Substation and loop line.

3.16.4.12 Irreversible and Irretrievable Commitments

Landform changes caused by the tailings impoundments would alter the scenery and would be an irreversible commitment of visual resources. Changes in scenery from other mine facilities would be an irretrievable commitment of resources. At the mine closure, disturbed areas would be regraded and revegetated, and all buildings and other constructed facilities would be removed. Reclaimed areas would have noticeably different lines, colors, and textures than the adjacent undisturbed landscape.

3.16.4.13 Short-term Uses and Long-term Productivity

Short-term uses affecting scenery would include construction of all proposed mine facilities and the transmission line. In addition, there would be the short-term effects from the presence of fugitive dust from construction activities, night lighting for construction operations, and vehicle traffic.

Long-term effects on scenery would be loss of vegetation and landform changes at all mine facilities and along the transmission line during the life of the mine. Following mine closure, landscape reclamation at all mine facilities, except the tailings impoundment, would create areas similar in appearance to abandoned roads and timber harvest areas. The tailings impoundment would have physical characteristics significantly contrasting with the surrounding landscape. Therefore, the scenic integrity and landscape character changes at the impoundment site would be noticeable indefinitely.

3.16.4.14 Unavoidable Adverse Environmental Effects

Visual impacts of all action alternatives would be unavoidable. Existing settings and landscapes in the analysis would be altered during mine operation and for several decades following operations.

3.17 Social/Economics

3.17.1 Regulatory Framework

3.17.1.1.1 Forest Plan

The KFP guides all natural resource management activities and establishes management standards for the KNF (USDA Forest Service 1987). The KFP establishes management direction in the form of prescriptions consisting of goals, objectives, standards, and guidelines. Goals provide information on the long-range management intent. The objectives and standards of both the forest as a whole and individual MAs must support the goals. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. All activities conducted on the KNF must contribute to the realization of the goals. The goal for mineral development is to "encourage responsible 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 KFP also establishes a goal of providing a sustained yield of timber volume responsive to market demands and supportive of a stable base of economic growth in the dependent geographic area. Management direction for the analysis area is described in more detail in section 3.14.3.2, *Kootenai National Forest Land Management Plan*.

3.17.1.1.2 Hard Rock Mining Impact Act

The Hard Rock Mining Impact Act is designed to assist local governments in handling financial impacts caused by large-scale mineral development projects. A new mineral development may result in the need for local governments to provide additional services and facilities before mine-related revenues become available. The resulting costs can create a fiscal burden for local taxpayers. The Hard Rock Mining Impact Board (HRMIB) oversees an established process for identifying and mitigating fiscal impacts to local governments through the development of a Hard Rock Mining Impact Plan. Under the Impact Act, each new large-scale hard-rock mineral development in Montana is required to prepare a local government fiscal Impact Plan. In the plan, the developer is to identify and commit to pay all increased capital and net operating costs to local government units that will result from the mineral development.

MMC updated the Impact Plan with the cooperation of the affected local governments (Western Economic Services, LLC 2005) and submitted it to Lincoln County for its review. Lincoln County approved the updated plan in 2007. Because the Montanore Project as currently proposed would change employment projections, MMC submitted an amendment for consideration by the HRMIB. The HRMIB approved the amendment in 2008.

3.17.1.1.3 Major Facility Siting Act

The purposes of the MFSA for the construction of electric transmission lines are to: ensure the protection of the state's environmental resources; ensure the consideration of socioeconomic impacts; provide citizens with an opportunity to participate in facility siting decisions; and establish a coordinated and efficient method for the processing of all authorizations required for regulated facilities. The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts considering the state of available technology and the nature and economics of the various alternatives.

3.17.2 Analysis Area and Methods

The socioeconomic analysis area is based on various factors that may influence the location and magnitude of potential socioeconomic impacts. Some of these factors include:

- The location of and access to the ore body and to the proposed permit area
- The likely residence area for people working at the mine (existing residents and/or any in-migrating project employees)
- The rate and magnitude of in-migration (which will be influenced by the availability of a trained or trainable local workforce and a developer-sponsored training program)
- The rate and magnitude of population and employee turnover (including student population turnover in schools, employee turnover at the mine, and employee turnover from existing jobs to employment with the Montanore Project)
- The availability and location of existing housing and potential housing and the capacity and condition of existing local services and facilities
- The people directly/indirectly affected economically by the proposed mining operation (*e.g.*, from wages and taxes)
- The willingness and ability of community residents and local government personnel to deal with change
- The allocation and magnitude of costs associated with in-migration of workers and allocation of tax revenues
- Impacts to Sanders County from removing ore and processing in Lincoln County

Based on these factors, the socioeconomic analysis area for the proposed project is Lincoln County and the Towns of Libby, Troy, and Eureka. Affected jurisdictions in the analysis area include the incorporated municipalities of Libby and Troy as well as the Libby, Troy, and Eureka School Districts (Western Economic Services, LLC 2005).

Economic effects to Sanders County would result primarily from the distribution of metal mines tax revenues to Sanders County. Relevant baseline information in Sanders County is provided in section 3.17.3.7, *Fiscal Conditions* because socioeconomic effects are likely to be limited to direct payments to Sanders County that would be distributed among various county agencies. Other baseline data for Sanders County related to population, housing, income, employment, and quality of life are not provided for because in-migrating mineworkers are not expected to establish residency there, and effects to Sanders County would be negligible (Western Economic Services, LLC 2005). Unless otherwise specified, socioeconomic data contained in this section are based on information provided in the *2005 Socioeconomic Report for the Mines Management Montanore Project* (Western Economic Services, LLC 2006).

3.17.3 Affected Environment

3.17.3.1 Population and Demographics

3.17.3.1.1 Historical Population Trends and Characteristics

Since 1950, Lincoln County has experienced relatively substantial fluctuations in its population. Lincoln County experienced the largest increase in population (44 percent) between 1960 and 1970 due to construction of Libby Dam. Between 1970 and 1980, Lincoln County's population

declined by about 1.7 percent. This decline is attributable to the out-migration of construction workers when Libby Dam was completed. Since 1990, the population recovered, by almost 8 percent, from 17,481 people in 1990 to 18,837 people in 2000 (Table 122). The U.S. Census Bureau's 2004 population estimate of 19,101 people in Lincoln County indicates that the population has grown by only 1.4 percent since 2000 (U.S. Census Bureau 2004).

Table 122. Lincoln County Population Characteristics (1970-2004).

Year	1970	1980	1990	2000	2004
Lincoln County	18,063	17,752	17,481	18,837	19,101
% Change		-1.7	-1.5	7.8	1.4
Libby	3,286	2,748	2,532	2,626	2,653
% Change		-16.4	-7.9	3.7	1
Eureka	1,195	1,119	1,043	1,017	1,023
% Change		-6.4	-6.8	-2.5	0.6
Troy	1,046	1,088	953	957	976
% Change		4.0	-12.4	0.4	2.0
Montana	694,409	786,690	799,065	902,125	926,825
% Change		13.3	1.6	12.9	2.7

Source: Western Economic Services, LLC 2006; U.S. Census Bureau 2006a.

In 2000, the median age for both males and females in Lincoln County was 42 years, compared to 38 years in the state. Lincoln County has seen an unusually high number of persons leaving the county between the ages of 25 to 34; this age bracket declined over 33 percent between 1990 and 2000 due to job losses. Lincoln County has experienced an increase in the number of older residents due to the popularity of second homes in rural mountain communities. From 1990 to 2000, people between the ages of 55 to 64 increased by 55 percent and people 65 or older increased 33.5 percent. These growth rates exceeded state growth rates over the same period, which were 25 percent for ages 55 to 64, and 14 percent for ages 64 and older.

3.17.3.1.2 Major Population Centers

Major population centers in Lincoln County include the towns of Libby, Troy, and Eureka. Libby is the largest town in Lincoln County, with about 15 percent of the population (Table 122). Each town's 2004 population was within 5 percent of 1990 populations. Population trends in Libby are similar to those described for the county. Compared to county and state statistics, Libby also has a higher percentage of its population over 65 years of age (Western Economic Services, LLC 2006).

3.17.3.1.3 Population Projections

The population of the county is projected to increase by 0.7 percent per year, rising from 18,866 people in 2004 to 22,740 people by 2030 (Table 123). Population projections for municipalities within Lincoln County were obtained by applying county population actual and projected growth rates from 1970 to 2030 to the municipalities. The population in Libby is expected to increase by 493 persons from 2,653 people in 2004 to 3,146 people in 2030. Troy's population is expected to increase by 187 people and Eureka's population is expected to increase by 195 people. Much of the projected population growth is attributed to expected increases in retirees and other older, more affluent newcomers.

Table 123. Population Projections for Lincoln County Municipalities and Lincoln County.

Year	Libby	Eureka	Troy	Lincoln County
2010	2,659	1,029	982	19,216
2015	2,731	1,057	1,009	19,738
2020	2,834	1,097	1,047	20,483
2025	2,975	1,152	1,100	21,505
2030	3,146	1,218	1,163	22,740

Source: U.S. Census Bureau 2004; Western Economic Services, LLC 2006.

3.17.3.1.4 Minority and Disabled Populations

Census data for Lincoln County are broken down within Census Tracts to show the distribution of minority, disabled, and low-income groups within the county. Libby is located almost entirely in Census Tract 2. Eureka is part of Census Tract 4 and Troy is part of Census Tract 5 (Table 124). In the 2000 Census, racial minorities comprised 2.1 percent of the total county population. Another 1.9 percent of the County population is comprised of two or more races.

Disability is defined by the Census Bureau as a lasting physical, mental, or emotional condition that makes it difficult for a person to do activities or impedes them from being able to go outside alone or to work (Western Economic Services, LLC 2006). In the 2000 Census, 4,012 people were classified as disabled in Lincoln County, or about 21 percent of the population. This compares to about 0.3 percent of the population statewide. The large numbered of disabled people can be attributed to former vermiculite mine workers from the W.R. Grace Mine that suffer from asbestos related diseases at a rate 40 to 60 times the national average.

3.17.3.2 Employment

Employment conditions for Lincoln County are presented in terms of historical employment trends, current types of employment, and baseline employment projections. Lincoln County's economy has typically centered on natural resource extraction industries such as mining and logging. Mining has historically been a dominant feature of the Lincoln County economy. The Rainey Creek and Fisher River districts, east of Libby, and the Sylvanite and Keystone districts, north of Troy, were productive mining areas prior to the 1940s, and gold, silver, copper, zinc, and lead were extracted from mines throughout Lincoln County. Until 1990 when the W.R. Grace mine was closed, Lincoln County was also the world's largest producer of vermiculite. Mining sector businesses comprised 0.6 percent of all businesses, and about 7.0 percent of all county employment in 1986. While the mining sector in 2003 still comprised 0.6 percent of all businesses in the County, it accounted for only 0.4 percent of the total employed in the county (Western Economic Services, LLC 2006).

Table 124. Population by Race and Ethnicity.

Race	Census Tract 1	Census Tract 2	Census Tract 3	Census Tract 4	Census Tract 5	Total	% Total Popu-lation
White	3,317	2,507	3,907	5,217	3,152	18,100	96.1
Black	2	4	3	4	8	21	0.1
AIAN	55	36	37	66	32	226	1.2
Asian	5	16	14	13	11	59	0.3
NHOPI	1	0	1	5	0	7	0.0
Some Other Race	13	14	20	13	14	74	0.4
Two or More Races	75	47	87	65	76	350	1.9
Total	3,468	2,657	4,069	5,383	3,336	18,913	100.0
Hispanic	46	33	68	81	43	271	1.4

AIAN = American Indian or Alaskan Native.
NHOPI = Native Hawaiian and Other Pacific Islander.
Source: Western Economic Services, LLC 2006.

According to the Montana Department of Labor and Industry, lumber and wood products comprised 42.1 percent of all manufacturing establishments and 89.7 percent of all manufacturing employment in 2000 for Lincoln County when Owens & Hurst Lumber, Plum Creek Lumber, and Stimson Lumber Company were the three largest lumber and wood product employers. During 2003, the latest data available, the lumber and wood products industry comprised 43.2 percent of all manufacturing establishments, and employment declined to 72.6 percent of manufacturing employment.

The strength of the lumber and wood products industry has historically been tied to the strength of the national housing and construction market, as well as the local availability of timber. Between 1993 and 2005, five lumber mills closed, leaving only Plum Creek with continuing operations in Lincoln County.

In 2003, the top three employment sectors in Lincoln County were government enterprises, retail trade, and healthcare and social assistance industries. The government enterprises sector, with 17.2 percent of total employment, was the largest single employer in Lincoln County. The retail trade sector was the next largest with 12.1 percent of total employment followed by the healthcare and social assistance sector with 10.2 percent of total employment (Table 125). Overall, the services sector (including trade, general services, utilities, and transportation) accounts for close to half of all employment. Contributing to the services sector is a vibrant recreation industry that provides visitors numerous camping, hiking, skiing, snowmobiling, hunting and fishing, wildlife viewing, and other recreation opportunities.

The top 10 private employers for Lincoln County during the third quarter of 2004, listed in alphabetical order, were Genesis Inc., Harlow’s School Bus Service, Libby Care Center, McDonalds (Libby), Mountain View Manor, Owens & Hurst Lumber, Plum Creek Timber, Rosauer’s Supermarkets, St John’s Lutheran Hospital, and Stein’s IGA.

Table 125. Lincoln County Employment Trends (2001 - 2003) for Major Industrial Sectors.

Industrial Sector	2001		2002		2003	
	Persons	%	Persons	%	Persons	%
Services (Trade, Service, Utilities, Transportation)	2,829	32.4	3,938	44.3	3,876	43.1
Finance, Government, Education	1,749	20.0	1,721	19.4	1,801	20.0
Goods Production (Construction/Manufacturing)	1,483	17.0	1,466	16.5	1,274	14.2
Resource Commodity (Agriculture, Mining, Forestry)	981	11.2	1,014	11.4	317 (D)	3.5 (D)
Total Employment	8,742		8,887		8,989	

Employment based on the number of full- and part-time jobs.
Note: (D) = Some data not included to avoid disclosure of confidential information; estimates included in totals.
Source: Western Economic Services, LLC 2006.

The labor force in Lincoln County, defined as persons working or seeking work, declined by 1,742 persons, from 8,501 in 1990 to 6,759 in 2004. This is a decline of 1.62 percent per year compared to an increase of 1.21 percent statewide.

In Lincoln County, the unemployment rate, the number of unemployed persons as a percentage of the labor force, increased from 12.4 percent in 1990 to 12.8 percent in 2004. This was nearly three times more than the unemployment rate of Montana, which was 4.4 percent during 2004.

Total employment in Lincoln County is projected to increase to 12,572 people by 2030. Increases in future employment would likely be attributed to growth in the services sector. This increase represents an annual growth rate of 1.3 percent between 2003 and 2030, higher than the historical 1970-2002 growth rate of 0.5 percent (Western Economic Services, LLC 2006).

3.17.3.3 Income

The median family income in Lincoln County was $31,784 in 2000, about 21.5 percent lower than the state-wide income of $40,487. Real per capita income in Lincoln County has been increasing at a rate of 1.1 percent per year, rising from $13,612 in 1969 to $19,832 in 2003. This compares to an annual growth rate of 1.9 percent real per capita income statewide. Lincoln County's average wage of $24,853 in 2003 was lower than the statewide average of $29,281. The top-paying sectors of the economy included the government ($44,135), manufacturing ($38,755), and information ($33,156).

Low-income concentration was estimated by taking into consideration all families that had 50 percent or less of the county's median family income. Families making less than $15,000 in each Census Tract in the county were considered low income. A total of 998 families, or 18.4 percent of the families countywide, had incomes below $15,000. Census Tract 5, which includes Troy, had the highest concentration with 24.4 percent of low-income families in the county. By comparison, families with incomes of less than $15,000 statewide comprised about 12 percent of the total (U.S. Census Bureau 2006b).

3.17.3.4 Economic Activities that Rely on Natural Resources

The following sections briefly describe economic activities in the study area that rely on natural resources such as recreation, logging, mineral exploration, and agriculture. The *Logging*, *Mineral Exploration*, and *Agriculture* sections discuss relevant activities near the analysis area, and are not discussed for all of Lincoln County. For additional information on these activities, please refer to sections 3.14, *Land Use* and 3.15, *Recreation*.

3.17.3.4.1 Recreation

National Forest System lands make up a large percentage of the Lincoln County land base, and offer public access for a variety of motorized and non-motorized recreational activities including: hunting for big game and upland game birds, fishing, hiking, wildlife observation, berry picking, photography, backpacking, horseback riding, snowmobiling, mountain biking, picnicking, sightseeing, OHV use, rock hounding, and camping. Recreational use on the KNF in 2002 was an estimated 1.1 million visits ±15.4 percent (USDA Forest Service 2003b).

Visitor use surveys indicate that KNF is a primary destination for many visitors to northwest Montana. About 25 percent of the 1,302 visitors interviewed were asked about the primary destination of their recreational trip. Of the 17 percent of visitors that also went to areas other than KNF, 89 percent said KNF was still their primary destination. In a typical year, visitors to KNF spent an average of $2,024 on all outdoor recreation activities including equipment, recreation trips, memberships, and licenses (USDA Forest Service 2003b).

3.17.3.4.2 Logging

The National Forest System lands of the Libby Ranger District provide about 6 to 8 million board feet (mmbf) of timber annually. No KNF timber sales are currently under contract in the land use analysis area as of May 2008. As discussed in section 3.3, *Reasonably Foreseeable Future Actions*, the KNF is currently considering the Miller-West Fisher Vegetation Management Project in the land use analysis area. Timber harvest activity also occurs on private, forest-industry lands. The amount of timber harvested has declined in the past 10 years. Small-scale timber harvests occur in the range of 2 to 6 mmbf annually on the private lands in the land use analysis area (Edwards, pers. comm. 2005). Logging has taken place along Libby Creek on public lands since the late 1960s. Timber was harvested from upper Libby Creek and Ramsey Creek following the Libby Creek Road extension in the mid-1970s, resulting in a number of clear-cut areas within the analysis area. Logging continues in the area, with new harvests in lower Ramsey Creek, upper Midas Creek, and much of Miller Creek. The Plum Creek Timber Company has clear-cut harvested several tracts of private land on lower Miller Creek and along the Fisher River (Power Engineers, Inc. 2005c).

3.17.3.4.3 Mineral Exploration

Some mineral activity occurs near the proposed mine. This activity includes small placer operations on Libby and Big Cherry creeks, small lode mining operations along Libby Creek, Snowshoe Creek, at the headwaters of the West Fisher Creek, and in the Prospect Hill area 4 miles south of Libby. A number of mineral operators do some form of work along the east face of the Cabinet Mountains each year (Power Engineers, Inc. 2005c).

3.17.3.4.4 Agriculture

No prime and unique farmland was identified near the proposed mining facilities; some land along U.S. 2 is used for hay and grazing. In addition, no land is enrolled in the Conservation

Reserve Program and no grazing allotments are present on nearby National Forest System lands (Power Engineers, Inc. 2005c). Four commercial apiaries are located near the proposed mining facilities. Commercial apiaries are used for honey production and/or pollination.

3.17.3.5 Housing

In 2000, the U.S. Census Bureau reported that Lincoln County had 9,319 year-round housing units and that Sanders County had 5,271 year round housing units. This was an increase of 16.5 percent in available housing in Lincoln County and 21.6 percent in Sanders County since 1990. Overall, the percent of owner-occupied housing units in both counties (about 76 percent) was higher than the state's 69 percent in 2000.

3.17.3.6 Public Services and Infrastructure

3.17.3.6.1 Schools

Eight elementary schools, three middle schools, and three high schools are located in Lincoln County. Troy Public Schools, Libby K-12 Schools, and Eureka Public Schools have an elementary, middle, and high school each. Fortine, McCormick, Sylvanite, Yaak and Trego have an elementary and middle school each. Total school enrollment for public schools in Lincoln County declined by 3.9 percent between 2001 and 2004.

3.17.3.6.2 Law Enforcement

Law enforcement services in the Lincoln County study area are provided by the Lincoln County Sheriff's Office, the Montana Highway Patrol, the Eureka Police Department, the Troy Police Department, and the Libby Police Department. Thirty full-time law enforcement officers were employed in Lincoln County in 2003. Two jail facilities occur within the study area: a 24-cell adult jail in Libby and a 4-bed juvenile holding facility in Troy.

3.17.3.6.3 Fire Protection

Fire protection in Lincoln County is provided by nine fire departments. The rural/city Libby Fire Department has two fire marshals and 28 volunteers, and the Troy rural/city Fire Department has 25 volunteers. The Montana Department of Natural Resources and Conservation and the Forest Service are responsible for fire protection in lands under their jurisdictions.

3.17.3.6.4 Health Care Facilities

Lincoln County has two healthcare centers: Prompt Care, a rural health clinic in Eureka, and Lincoln Community Health Services in Libby. Lincoln County's healthcare facilities also include the St. John's Lutheran Hospital, a critical access hospital in Libby. This not-for-profit 25-bed medical facility offers 24-hour emergency care services. The Troy area medical facilities include the Medicine Tree Primary Care and the Troy Medical Arts Complex. Lincoln County is served by 15 licensed physicians, six nursing practitioners, three physician's assistants, eight dentists, and seven dental hygienists.

3.17.3.6.5 Water Supply

More than 50 percent of the households in Lincoln County use private wells for their water supply. About 4,750 households in Libby, 1,000 households in Troy, and 1,100 households in Eureka are served by a municipal water system. Libby obtains its water from Flower Creek. Troy receives its municipal water supply from two wells and O'Brien Creek.

3.17.3.6.6 Wastewater Treatment

Libby has operated a public wastewater treatment facility since 1964, and converted from a primary to a secondary treatment facility (*i.e.*, an activated sludge oxidation ditch system) in 1985. In Troy, sewer service is obtained for a fee of $34.27 for residential and $38.97 for commercial service.

3.17.3.6.7 Utilities

Residential telephone service in the Lincoln County study area is provided by Frontier, a subsidiary of Citizens Communications. The long distance service is provided by AT&T. Electric service for Libby is provided by Flathead Electric Cooperative. Lincoln Electric Cooperative is an electric distribution cooperative headquartered in Eureka, providing electricity service to northeast Lincoln County. Northern Energy provides propane to the local area. Northern Lights, Inc. is the electricity provider in the Troy area. Heating sources in the analysis area include fuel, oil, propane, wood, and electricity.

3.17.3.7 Fiscal Conditions

The proposed project would affect the public budgets of Lincoln and Sanders counties, Libby, Troy, Eureka, and those cities' school districts. Basic descriptions of key budget areas for each of these jurisdictions are presented in the following sections.

3.17.3.7.1 Lincoln County

Total taxable property valuation in Lincoln County declined from $30.5 million in fiscal year (FY) 1992 to $25.2 million in FY 2004. This amounts to a decline of $5.3 million, or 1.6 percent per year, with no accompanying decrease in population. While taxable valuation in Lincoln County has declined, county levies increased from 49.48 mills in FY 1992 to 87.13 mills in FY 2004.

Total revenues in Lincoln County increased at a rate of 4.0 percent per year, from $10.23 million in FY 1996 to $13.5 million in FY 2003. The major source of revenue to Lincoln County government was intergovernmental revenues, at 47 percent of all revenues to the county during FY 2003. Total county expenditures also increased at a rate of 5.2 percent per year between FY 1996 and FY 2003, from $9.1 million in FY 1996 to $12.9 million during FY 2003. In FY 2003, 21 percent of the budget was spent on general government, 19.3 percent on public safety, and 33.6 percent on public works. Road maintenance costs are classified under public works expenditures. Lincoln County expenses on road maintenance declined from $2.79 million in FY 1996 to $2.46 million in FY 2003. Road maintenance costs comprised 73.2 percent of the total budgeted expenditure on public works in FY 1996. While road maintenance costs appear to have declined by FY 2003, they still represent 56.6 percent of the total budgeted expenditure on public works.

3.17.3.7.2 Municipalities

Taxable valuation for Libby declined from $3.6 million in FY 1992 to $2.5 million by FY 2004, representing a 1.8 percent decline per year in the tax base. Total revenues for Libby increased from $1.91 million in FY 1996 to $2.54 million in FY 2003. Total expenditures for Libby also increased from $1.92 million in FY 1996 to $3.67 million in FY 2003. About 45 percent of the budgeted expenditure during FY 2003 was spent on public works, which includes road maintenance costs.

Taxable valuation in Troy increased from $679,000 in FY 1992 to $699,000 in FY 2004, an increase of 0.2 percent per year. Total revenues for Troy from taxes average from $76,000 to $79,000 per year. Expenditures for general government in Troy usually require about 40 percent of the budget, and expenditures for public safety also require about 40 percent of the budget.

Total revenues for Troy increased from $1.28 million in FY 1996 to $1.53 million in FY 2003. The major source of revenue to the city during FY 2003 was from charges for services, about 76 percent. Total expenditures for Troy also increased from $1.79 million in FY 1996 to $2.02 million in FY 2003. About 81 percent of the budgeted expenditure during FY 2003 was spent on public works, which include road maintenance costs. Taxable valuation in Eureka increased from $878,000 in FY 1992 to $923,000 in FY 2004, an increase of 0.4 percent per year. Total revenues for Eureka increased from $690,800 in FY 2002 to $835,000 in FY 2003. Total expenditures for Eureka also increased, from $606,500 in FY 1996 to $783,400 in FY 2003.

3.17.3.7.3 School Districts

The taxable valuation for all school districts in Lincoln County decreased at a rate of 1.9 percent per year, from $32.35 million in FY 1991 to $25.36 million in FY 2004. Countywide mill levies to support schools have remained at about the same level since 1991. Taxable valuation for Troy Public Schools experienced a sharper decline compared to the County. Taxable valuation for the elementary school declined by 4.8 percent per year, from $7.47 million in 1991 to $3.77 million in 2004. High school valuation declined 3.5 percent per year, from $8.26 million in 1991 to $5.0 million in 2004. Taxable valuation for Libby K-12 Public Schools experienced a decline of 2.9 percent per year, from $17.5 million in 1991 to $11.5 million in 2004.

Contrary to the county tax base, taxable valuation for Eureka Public Schools experienced an annual increase of 2.9 percent for the elementary school, and 2.1 percent for the high school. Taxable valuation for the elementary school increased from $4.37 million in FY 1991 to $6.53 million in 2004. High school valuation increased from $6.62 million in FY 1991 to $8.85 million in 2004.

Taxable valuation for Fortine Elementary School experienced a decline of 0.2 percent per year, from $1.3 million in 1991 to $1.25 million in FY 2004. Taxable valuation for McCormick Elementary School experienced an increase of 0.7 percent per year, from $347,147 in FY 1991 to $383,702 in FY 2004. Taxable valuation for Sylvanite Elementary School experienced an increase of 4.1 percent per year, from $174,791 in FY 1991 to $305,835 in FY 2004. Taxable valuation for Yaak Elementary School experienced an increase of 5.2 percent per year, from $266,573 in FY 1991 to $540,676 in 2004.

3.17.3.7.4 Sanders County

Total taxable valuation in Sanders County increased slightly, from $24.13 million in FY 1992 to $26 million in FY 2004. This is an increase of $1.9 million, or 0.6 percent per year. The major component of the tax base in Sanders County during FY 2004 was land and improvements, which comprised about 40 percent of the total taxable valuation. Countywide levies also increased, from 66.59 mills in FY 1992 to 106.83 mills in FY 2004. This increase is primarily due to mills levied for the improvement of the town of Paradise.

Total revenues in Sanders County increased from $5.53 million in FY 1996 to $6.54 million in FY 2003. The major source of revenue to Sanders County government has been from taxes and assessments, which increased at the rate of 6.2 percent per year between FY 1996 and FY 2003.

Total county expenditures in Sanders County also increased, from $3.94 million in FY 1996 to $6.45 million in FY 2003.

3.17.3.8 Quality of Life and Lifestyle

Social structure and interaction in Lincoln County have been shaped primarily by geographic isolation, migration, and settlement; a resource-extractive economy; extra-local influence on the economy; and a cyclical economy. A cultural overview for the analysis area is provided in section 3.7, *Cultural Resources*.

Geographic isolation and, consequently, social isolation have a homogenizing effect on the population because communities and interaction are directed to one's own group or community. As a result, similar values and social views develop among individuals and social bonds form, leading to a collective view of and commitment to the community.

Libby area residents have adapted to the cyclic nature of the economy by living off the land (*i.e.*, hunting, fishing, gardening, firewood gathering, and berry picking). Local residents tend to acquire vehicles, homes, and other possessions that are functional rather than ostentatious (Western Economic Services, LLC 2006). Residents of Lincoln County, because of their livelihoods, are closely linked to the natural environment, and have a conservation ethic. Residents do not favor preservation that would prohibit development of natural resources, but rather promoting stability through healthy local economies, lifestyles, and use of natural resources in a sustainable fashion.

A quality of life survey conducted with Lincoln County residents indicates that residents highly value the natural environment and rural, small town atmosphere of the area (Western Economic Services, LLC 2006). Limited economic opportunities were cited as the largest drawback of the area, although residents feel positive about the county as a place to live.

Community services are generally viewed as average, with the exception of fire protection and rescue, which is rated above average. Day-to-day shopping varies from Libby, to Kalispell, Missoula, or other avenues such as catalogues and the internet, and respondents cite the limited selection of goods as a drawback to local businesses. Shopping for major purchases is generally done in Libby, Spokane, or Missoula.

Social problems in the area reported by survey respondents include drug and alcohol abuse, family problems or domestic abuse, poverty, and unemployment. Alcoholism and drug abuse were cited most frequently by about half of the respondents. Libby is also now in the midst of addressing hundreds of deaths and illnesses linked to former vermiculite mining operations.

In the 1920s, mining of a large vermiculite deposit north of Libby began. W.R. Grace owned and operated a vermiculite mine and vermiculite processing facilities in Libby from 1963 to 1990. The vermiculite deposits in Libby were contaminated with a form of asbestos similar to tremolite. Asbestos is regulated under the Clean Air Act as a hazardous air pollutant. Studies have shown that exposure to asbestos can cause life-threatening diseases, including asbestosis, lung cancer and mesothelioma. Mining and processing activities resulted in the spread of vermiculite – and the associated asbestos fibers – to numerous homes, businesses, and schools throughout the town. Health studies on residents of the Libby area show increased incidence of many types of asbestos-related disease, including a rate of lung cancer that is 30 percent higher than expected when compared with rates in other areas of Montana and the United States. The health problems

resulting from the vermiculite mine have resulted in premature deaths, increased health costs, and social division in the Libby area.

The analysis area, like much of the Intermountain West, has seen an increase in rural residences. Many of these rural residences are second homes. The census does not count second-home owners as part of a community's population, thus the impacts of second homes are not readily apparent from changes in population. These second homes can have an impact on local government finances and quality of life issues.

3.17.4 Environmental Consequences

The socioeconomic effects for the No Action Alternatives and the action alternatives were evaluated. The impacts for all of the action alternatives would be the same, so the discussion of Alternatives 2 through 4 and the all the transmission line alternatives was combined.

3.17.4.1 Alternative 1 – No Mine and Alternative A – No Transmission Line

In the No Action alternatives for the mine and the transmission line, the proposed mine and transmission line and substation would not be developed, and existing patterns and trends described in section 3.17.3, *Affected Environment* would continue to drive the social structure and economy of the area. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Economic effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.17.4.1.1 Employment and Income Effects

Lincoln County total employment is projected to increase to 12,572 people by 2030. Increases in future employment likely would be attributed to growth in the services sector. This increase would be an annual growth rate of 1.3 percent between 2003 and 2030 (Western Economic Services, LLC 2006).

During 2003, the average wage for all workers in Lincoln County was $408 per week, which was about 21.2 percent lower than the average wages of workers statewide. Within industry groups, the average wage in Lincoln County is less than the state average for corresponding groups, except for jobs in the agriculture, forestry and fishing, manufacturing, and educational service sectors. The highest paying jobs in Lincoln County are manufacturing jobs, which paid over 2.3 percent more than the average statewide in 2003 (Western Economic Services, LLC 2006).

3.17.4.1.2 Population Effects

Lincoln County population is projected to increase by 0.7 percent per year, rising from 18,866 people in 2004 to 22,740 people by 2030. The population in Libby is expected to increase by 493 persons from 2,653 people in 2004 to 3,146 people in 2030. Troy's population is expected to increase by 187 people and Eureka's population is expected to increase by 195 people. Much of the projected population growth is attributed to expected increases in retirees and other older, more affluent newcomers. Total school enrollment for public schools in Lincoln County declined by 3.9 percent between 2001 and 2004. This decline in enrollment is projected to continue at a rate of 1.6 percent annually between 2004 and 2010 (Western Economic Services, LLC 2006).

The in-migration of retired persons to the area (expected to accelerate as the Baby Boom generation begins to retire), combined with in-migration of persons whose employment allows them to live where they choose, is expected to be the most important factor underlying social and economic developments in the region over the next 25 years. Lincoln County is expected to see minimal impact from any larger regional pattern and to continue its slow pace of growth and change. What growth it does see would likely come from the finance, education, government, and service sectors of the economy.

3.17.4.1.3 Community Effects

Existing patterns of development for communities within Lincoln County may be altered as the land use implications of population growth associated with retirement, amenity, and recreation/tourism development are integrated into these communities. Based on the experience of areas like Montana's Bitterroot and Flathead valleys, community development of recreation/tourism based economies can be more dispersed outside of established communities. Lands in private ownership that have supported timber or agricultural production and provided open space are converted to residential subdivisions and ranchettes. During the transition, land use conflicts often arise from the incompatibilities between timber or agricultural production activities and residential use. In some areas domestic water supply and waste treatment pose significant problems. The severity of the problems associated with these land use changes would depend mostly on their pace and extent. Overall, Lincoln County is expected to continue its slow pace of growth and change, and with minimal impact from the larger regional pattern on land use and housing.

3.17.4.1.4 Public Services

Based on existing trends and emerging demographic characteristics for the study area, Lincoln County is expected to experience a substantial reduction in school-age population and enrollment paired with a dramatic increase in the retirement-age sector. This pattern has particular implications for community services. It reduces demand for school facilities and services, but it also produces a voting population that may not be supportive of tax measures needed to maintain existing facilities and cover operating costs. An aging population has fewer people likely to be involved in criminal activity, but a high proportion that may become crime victims. It also is a population that has a high need for medical and emergency response services and community transportation.

3.17.4.2 All Action Alternatives – Includes Transmission Line

3.17.4.2.1 Employment and Income Effects

The U.S. Forest Service produced an analysis of potential employment and labor income effects from the proposed Montanore Project (termed the "Forest Service Effects Analysis" in this section) (USDA Forest Service 2007c) for use in this EIS. The Forest Service Effects Analysis describes potential employment and labor income estimates of the proposed project during specific years within the four project phases:

- Construction phase at Year 3 of the proposed project (peak employment during the construction phase)
- Production phase at project Years 4 through 19
- Post-mining closure phase at Years 20 through 22

- Reclamation and monitoring phase at Years 23 through 42

Project employment and income and the duration of the mine-life phases could vary from projections, depending upon construction progress and the resources applied by MMC toward full-scale operations. Mineral and input market conditions also could cause operations to be curtailed or shut down on short notice at any point during projected mine life.

Employment and income impacts were estimated in the Forest Service Effects Analysis using input-output analysis. Input-output analysis is a means of examining relationships within an economy between businesses, and between businesses and final consumers. Three types of economic impacts (effects) are identified in the analysis: direct, indirect, and induced. Direct effects are production changes associated with the immediate effects of changes in expenditure tied to mine construction, production, post-mining closure, and reclamation and monitoring. Indirect effects are production changes resulting from spending in all phases of operations in industries that supply products and services to construction, production, mine closure, and reclamation and monitoring. Induced effects are changes in economic activity resulting from households spending income earned directly or indirectly as a result of all phases of the proposed project. The sum of indirect and induced effects are referred to as secondary effects, which is the term used in the remainder of the discussion.

Other specific information on the methodological approach and assumptions used in the analysis presented below can be found within the Forest Service Effects Analysis report. Projected employment and labor income effects identified in the Forest Service Effects Analysis are presented below.

3.17.4.2.2 Construction and Production Employment and Income Effects

The estimated total employment during the construction phase of the proposed project would be 581 jobs at Year 3 (Table 126). About 21 percent of the direct employment would be construction related and the remainder attributable to production. The input-output model estimated that there would be about 270 secondary jobs associated with the estimated 310 direct jobs.

Employment during the production phase would vary with the production rate (Table 126). For production Years 4 through 8, total employment would vary from about 500 jobs in Year 4 to about 400 jobs in Years 5 through 8. Fewer employees are needed during the production phase than for the construction phase. Secondary employment would account for about 190 jobs in Year 4 and would drop to about 150 jobs during Years 5 through 8. In Year 9, the production rate is expected to increase from 12,500 tons per day to 17,000 tons per day. Direct mine employment would increase from 246 jobs to 450 jobs during this production increase. Secondary employment also would increase from about 150 jobs to 260 jobs. At Year 14, production is expected to increase from 17,000 tons per day to 20,000 tons per day. During this production increase, direct employment would remain at 450 jobs and secondary employment would increase slightly.

Table 126. Construction and Production Employment Estimates.

Category	Construction Phase	Production Phase			
Project Year	3	4	5-8	9-13	14-19
Production rate (tons per day)	0	12,500	12,500	17,000	20,000
Employment					
Construction (direct)	65†	65†	0	0	0
Operations (direct)	246	246	246	450	450
Secondary employment	270	188	149	263	268
Total construction and operations	581	499	395	713	718

† Includes estimated 23-person crew required for construction of the 230-kV transmission line.
Source: MMC 2008.

At Year 3 of the proposed project, direct labor income would be about $15.9 million and total income would be $22.2 million (Table 127). About 23 percent of the direct labor income would be construction related and the remainder is attributable to production. The 23-person crew required for construction of the 230-kV transmission line would account for about 35 percent or $1.3 million of the direct labor income for construction in each of the Years 3 and 4. Estimated total labor income would range from a low of $16.1 million in project Years 5 through 8 to a peak of $29.2 million in Years 14 through 19 during the production phase. The increased labor income would correspond to the expansion in mine production. In general, with the exception of Years 5 through 8, estimated total labor income would exceed $20 million. On a per-job basis, direct annual labor income for construction and operations employment would average about $57,000 and $50,000, respectively. Annual labor income for secondary employment would be about $26,000 per job.

Table 127. Construction and Production Labor Income Estimates.

Category	Peak Construction Phase	Production Phase			
Project Year	3	4	5-8	9-13	14-19
Production rate (tpd)	0	12,500	12,500	17,000	20,000
Labor Income					
Construction (direct)	$3.7	$3.7	$0.0	$0.0	$0.0
Operations (direct)	$12.2	$12.2	$12.2	$22.3	$22.3
Secondary labor income	$6.3	$4.7	$3.9	$6.5	$6.9
Total construction and operations income	$22.2	$20.6	$16.1	$28.8	$29.2

Income shown in 2003 Million $. Actual totals may differ from values shown due to rounding.

3.17.4.2.3 Post-mining Closure, and Reclamation and Monitoring Employment and Income Effects

MMC expects the post-mining closure phase of the proposed project to last about 3 years. Total employment would be about 200 jobs for the first 2 years and would decline to about 125 jobs in the third year (Table 128). Secondary employment would account for about 40 percent of the total employment during the post-mining closure phase.

The reclamation and monitoring phase of the proposed project would follow the post-mining phase and last about 20 years. This phase also would include consolidation of the tailings and placement of the final cover on the tailings impoundment described in section 2.4.3.1.6, *Tailings Impoundment and Borrow Areas*. Total employment (about 80 jobs) would peak in the first 2 years of this phase and decline to about 30 jobs thereafter. Secondary employment would account for about 38 percent of the total employment during this phase of the proposed project. The second phase would consist on longer-term maintenance of specific facilities, such as the Libby Adit Water Treatment Plant or the seepage collection facilities at the tailings impoundment. MMC would maintain and operate these facilities until water quality standards in all receiving waters could be met by any project discharge. MMC also would continue monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment operates, the agencies would require a bond for the operation and maintenance of the water treatment plant. Human activity associated with facility maintenance and monitoring is expected to be limited, and indistinguishable from current recreational use. The length of time that the second phase of closure activities would occur is not known, but may be decades or more.

Table 128. Post-mining and Reclamation Employment Estimates.

Category	Post-mining Closure Phase			Reclamation and Monitoring Phase		
Project Year	20	21	22	23	24	25-42
Employment						
Contractors (direct)	0	75	50	25[†]	25[†]	10
Company workforce (direct)	125	50	25	25	25	10
Secondary employment	76	86	52	31	31	12
Total contractors and company	201	211	127	81	81	32

[†] Includes estimated 23-person crew required for removal of the 230-kV transmission line.
Source: MMC 2008.

Table 129 displays labor income in 2003 dollars for the post-mining closure, and reclamation and monitoring phases of the proposed project. Direct labor income was based on a workforce consisting of operations, technical, administrative, and environmental services skills. Total labor income during the post-mining phase of the proposed project would be about $7.6 million for each of the first 2 years and would decline to about $4.6 million in the third year. Secondary labor income accounts for about 20 percent of the total labor income during the post-mining closure phase.

Total labor income (about $2.9 million) would peak in the first 2 years of the reclamation and monitoring phase, and would decline to about $1.2 million thereafter. The 23-person crew required for removal of the 230-kV transmission line would account for about 92 percent or $1.1 million of the total labor income for direct contractors in each of the first 2 years of the reclamation and monitoring phase. Secondary labor income accounts for about 16 percent of the total labor income during this phase of the proposed project.

Table 129. Post-mining and Reclamation Labor Income Estimates.

Category	Post-mining Closure Phase			Reclamation and Monitoring Phase		
Project Year	20	21	22	23	24	25-42
Labor Income						
Contractors (direct)	$0.0	$3.9	$2.6	$1.2	$1.2	$0.5
Company workforce (direct)	$6.2	$2.5	$1.2	$1.2	$1.2	$0.5
Secondary labor income	$1.3	$1.4	$0.8	$0.5	$0.5	$0.2
Total contractors and company income	$7.5	$7.8	$4.6	$2.9	$2.9	$1.2

Income shown in 2003 Million $. Actual totals may differ from values shown due to rounding.

The mine would become one of the largest single employers in the area, so any changes in operation or production would impact employment levels. Once the local economy had adjusted to a particular operating level, any reductions-in-force would release individuals whose life style would be attuned to mine wage rates and who would find very few opportunities for comparable employment in the local market. Any shutdown of operations for a few weeks or months would cause a sudden drop in local area income while laid off workers, expecting a resumption of operations, would be unlikely to seek other work. While the affected communities, government jurisdictions, and businesses can plan for mine closure, effects of closure after the planned 20-year production period would result in a drop in employment earnings. Unless other large mining projects are operating in the area at the time, closure of the Montanore mine would eliminate many of the resource commodity sector jobs expected to exist in the local area economy in 2030.

3.17.4.2.4 Population Effects

The employment and income effects analysis summarized above assumes that all employment demand would be met from the Lincoln County labor supply. This assumption could occur if a large local population, or a high rate of unemployment in the relevant skill sets, provided a large pool of available labor. Lincoln County does have a higher than average unemployment rate in comparison to neighboring counties and the state as a whole, but given the number of workers needed and the specialized skills required for the construction and production phases of the proposed project, not all employment demand would be met by Lincoln County residents. Thus, some mine workers would move to the area or commute from locations outside of Lincoln County.

Recent experience for large projects indicates that mining and construction workers will tolerate one-way commuting times of about one hour. Beyond that distance, workers may be more likely to relocate closer to the project site (USDA Forest Service and DEQ 2001). For the Montanore Project, this implies a local employment area that could include all of Lincoln County including the towns of Libby, Troy, and Eureka. If non-local workers (*e.g.*, residents outside of Lincoln County) were to move into Lincoln County for project-related jobs, population within Lincoln County would increase.

Since the proposed Montanore Project is classified as a "large-scale mineral development," according to the requirements in the Montana Hard-Rock Mining Impact Act, the project proponent is required to evaluate potential impacts to affected local government units as a result of in-migrating workers and their families and prepare a Hard-Rock Mining Impact Plan (Impact Plan). The Impact Plan for the Montanore Project was prepared in 2005 and approved by Lincoln County in 2007. The Impact Plan estimates the number of in-migrating direct and secondary workers and their family members associated with the project. Table 130 shows the total number of estimated in-migrants and Lincoln County population increase for project Years 1-5, covering the three-year construction period and the first two years of production. In-migration is expected to peak in the fourth year of the project at the beginning of the production phase and level off for the rest of the production years.

Table 130. Population In-migration Estimates.

Category	Construction Phase			Production Phase	
Project Year	1	2	3	4	5
Total Estimated Population In-Migration into Lincoln County	171	339	425	429	412
Percent Addition to 2004 Lincoln County Population (18,866)	0.9 %	1.8%	2.3%	2.3%	2.2%

Source: Western Economic Services, LLC 2005.

3.17.4.2.5 Community Effects

The Impact Plan projected the allocations of in-migrating population to various settlement locations in Lincoln County including Libby, Troy, Eureka, and rural areas. Projections of in-migrating population from the beginning of mine construction through initial full production operations (*e.g.*, project Years 1-5) are presented in Table 131. Rural Lincoln County and Libby are predicted to receive the highest levels of new population.

Table 131. Expected Settlement Locations during Mining Operations.

Category	Construction Phase			Production Phase	
Project Year	1	2	3	4	5
Direct Construction and Production Employees					
Libby	35	72	94	95	94
Troy	2	5	6	6	6
Eureka	1	2	3	3	3
Rural Lincoln County	69	141	184	186	183
Total	107	220	288	291	287
Secondary Employees					
Libby	21	39	45	46	41
Troy	1	3	3	3	3
Eureka	1	1	1	1	1
Rural Lincoln County	41	76	89	89	81
Total	65	118	138	139	126
Combined Total In-Migration by Area					
Libby	56	111	139	141	135
Troy	3	8	9	9	9
Eureka	2	3	4	4	4
Rural Lincoln County	110	217	273	275	264
Total	171	339	425	429	412

Totals may not add due to rounding.
Source: Western Economic Services, LLC 2005.

The in-migration projections above incorporate the expectation that housing would be the primary limiting factor on the settlement of in-migrating workers, at least during early project years. Specifically, these projections assume that, with or without assistance from MMC, some temporary housing facilities would be developed near the project site on private lands. Such facilities would enable more workers to settle in this area than existing housing allows. Development of new housing to meet the needs of the entire expected non-local contract construction labor force is unlikely. Because of housing constraints, many would be forced to commute longer distances. Individuals hired for long-term mine jobs would have difficulty finding local housing. Some would have to settle initially in communities more distant from the mine and then relocate to permanent residences in the Libby/Troy/Eureka area after contract construction workers had left the area.

As noted in the Alternatives 1 and A, discussion of land use trends, population growth in the area is converting areas of private land from timber or agricultural production and open space use into residential subdivisions and ranchettes. The demand on public land resources is also shifting away from traditional resource commodity production toward a greater emphasis on recreation, and aesthetic values. Mine development would add to population and housing demand pressures. Land use demand driven by mine development would differ somewhat from the existing pattern driven by retiree and recreation/tourism/amenity in-migrant population growth. Although some mine employees would compete in the same market as other in-migrants for relatively large residential properties offering good scenic or other amenity values, most mine production

workers would be more likely to seek properties providing good basic family housing locations. The development of local businesses catering to new residential areas and commuting mine workers also would be expected.

Mine operations workers would have the kind of secure jobs with above-average wages that would allow them to purchase or build homes. Some in-migrants hired into secondary and replacement jobs would be in the same situation. Others would be more likely to need rental housing or mobile home spaces. In-migration during mine operations would place less strain on local housing supplies than would the earlier influx of construction workers.

While some in-migrants would be expected to become long-term residents and would seek to become integrated into the community, others would be well aware of their temporary status and unlikely to participate. An influx of temporary residents with large cash incomes, few ties to the community, and limited social and recreational opportunities may pose problems for limited law enforcement resources. To what extent these phenomena would surface in the western Lincoln County communities is difficult to predict, but it would be unrealistic not to expect some detrimental effects from the influx and departure of the large contract construction workforce.

3.17.4.2.6 Public Services

Local governments would need to serve fluctuating populations. Impacts to specific local governmental units within the study area due to in-migrating workers and their families depend entirely upon where the in-migrants choose to reside. In addition to housing-related factors affecting settlement patterns, in-migrants also would consider the availability of public services in making their residency choices.

Local government service-providers would have to plan for and deal with an influx of an estimated 171 in-migrants in the first year of mine construction followed by an expected peak in the fourth project year with about 429 total net in-migrants. The population increases during mine startup could cause difficulty for some service providers in responding to demands, requiring change in staffing and resource allocation. Because Lincoln County school enrollments were projected to decline over the next 10 to 15 years (if the mine were not developed), the arrival of students associated with mine operations would not be expected to create staffing or capacity difficulties.

Small communities that lack temporary housing facilities as well as a wide range of public and private services may experience law enforcement problems when a large temporary work force with no community ties, above-average income, marginal housing, and a high percentage of individuals who are not accompanied by families suddenly arrives. If such problems were to develop in association with the startup construction phase of the Montanore Project, these individuals would be more likely to reside in the communities located nearest to the mine site.

Community fire, emergency, medical, and social service providers would benefit from the additional tax revenues generated by the mine and should be able to adapt to the long-term changes in demand associated with mine operations. These service providers could have a hard time adjusting their staffing to the increases in service demands associated with mine construction and startup. Obtaining and training new staff takes time, and the fire and ambulance services, in particular, could experience difficulty finding and training additional volunteers. It is anticipated that the mine would maintain its own ambulance and would support and cooperate with local emergency service providers.

Projected revenues to meet the anticipated increase in public services costs are discussed in section 3.17.4.2.7, *Fiscal Effects* below.

3.17.4.2.7 Fiscal Effects

The proposed project would increase local and state government revenues and expenses. The Impact Plan included an analysis of project-related revenues and costs to affected local governments from the mine operations and population increases. Affected local government units within the defined Impact Plan study area include:

- Lincoln County Government (including special districts)
- City of Libby
- City of Troy
- City of Eureka
- Libby School District
- Troy Elementary School District
- Troy High School District
- Eureka Elementary School District
- Lincoln County High School District

New project-related revenues to local governments would come from three primary sources: property taxes on the mine land, plant, and equipment; the gross proceeds tax on the value of ore produced; and property taxes on new homes and commercial facilities built as a result of mine development. The project would increase costs for cities, schools, and counties through mine-related in-migration and resulting increases in local government service costs. The additional tax revenue would be used by local governments to pay for capital outlays, personnel, and support costs.

Lincoln County and the Libby, Troy, and Eureka school districts would be the primary recipients of tax revenues on the mine and mill facilities, but Montana law provides for tax-base sharing among affected Montana local government units when a mine is designated as a large-scale mineral development.

When construction of mine facilities is completed, the property tax revenue would be about $2.35 million represented by the land and improvements (*i.e.*, Class 4 property) and all the business equipment (*i.e.*, Class 8 property) (Western Economic Services, LLC 2005). This tax revenue would decline as the mine facilities and equipment depreciated, reaching fully depreciated values in 10 to 15 years. Annual local tax revenues would depend on local mill levy rates, state property tax equalization, and property tax prepayments and credits.

Montana levies a metal mines license tax on a mine’s annual gross revenues in excess of $250,000. This is a percentage tax on the value of ore concentrate shipped to the refinery. Tax revenues would fluctuate depending on silver and copper prices and the project’s annual production levels. By law, 75 percent of these revenues would be allocated to Montana’s general fund. The remaining 25 percent would be allocated to Lincoln County, and distributed through the county to appropriate departments and districts. The county would be required to reserve at least 37.5 percent of this revenue in a trust fund account. All money not allocated to the trust fund

account is distributed as follows; 33.3 percent to elementary school districts, 33.3 percent to high school districts, and 33.3 percent for general planning functions (*e.g.*, economic development activities).

Table 132 summarizes projected fiscal effects from the project. Net impact to local governments would start with a $180,242 deficit in Year 1, followed by net surpluses starting in Year 2 with a net surplus of about $4.8 million in Year 5. MMC's proposed mitigation of $180,000 would mitigate for the Year 1 fiscal deficit. While not directly affected by the Montanore Project, Sanders County would receive $208,000 in gross proceeds tax in Year 4 and $546,000 in Year 5 (Western Economic Services, LLC 2005). The projected fiscal effects shown in Table 132 should be considered representative of actual fiscal effects, which would depend on a number of currently unknown factors and future local government conditions.

3.17.4.2.8 Quality of Life and Lifestyle

The Montanore Project would have relatively minor effects on social well-being and quality of life in the analysis area. Mining and other natural resource development has been an important part of the local economy for many years. Integration of newcomers should occur relatively easily. Individuals and social groups within the community would perceive project-related benefits, such as increased economic opportunity, and costs such as social problems associated with population growth, from the perspective of their own values, beliefs, and goals. Such perceptions would of course vary. Increased income within the analysis area would create new opportunities in the retail sales and service sector. Some residents believe the proposed project would revitalize and stabilize the depressed local economy.

Negative perceptions of project development may be attributed to people with various other points of view. Many residents express anxiety at the prospect of a major mineral development project, based on their experience with and perceptions of other mining projects. These concerns primarily are that the Montanore Project might generate similar problems, and that state and federal agencies might not adequately monitor and enforce applicable laws and regulations. Persons having these views want their feelings known, but are not necessarily opposed to development of the Montanore Project.

3.17.4.3 Cumulative Effects

In addition to the proposed Montanore Project, the proposed Rock Creek Project would affect Lincoln County. Other mineral activities in the area (*i.e.*, primarily small exploration projects) and the regional timber industry are not expected to lead to major developments in the reasonably foreseeable future.

The Rock Creek Project is a proposed underground copper and silver mine and mill/concentrator complex near Noxon, in Sanders County, Montana. The project is owned by Revett Silver, a wholly owned subsidiary of Revett Minerals, Inc. The nearest town to the proposed Rock Creek development is Noxon, an unincorporated town on Montana Highway 200 in Sanders County. Access to the Rock Creek mine would be from the Noxon area, and mine facilities also would be located in Sanders County.

Table 132. Net Local Government Fiscal Impact due to Montanore.

Category	Construction Phase			Production Phase	
Project Year	1	2	3	4	5
Costs					
Direct Worker Local Government Costs	$253,797	$563,239	$786,312	$798,962	$813,366
Indirect Worker Local Government Costs	$128,987	$236,679	$277,825	$281,063	$255,531
Total Costs to Units of Local Government	**$382,784**	**$799,918**	**$1,064,137**	**$1,080,025**	**$1,068,897**
Revenues					
Montanore Taxes:					
Metal Mines License Tax (to Lincoln County†)	0	0	0	$215,000	$565,000
Gross Proceeds Metal Mines Tax (to Lincoln County‡)	0	0	0	$832,000	$2,184,000
Gross Proceeds Metal Mines Tax (to Sanders County)	0	0	0	$208,000	$546,000
Montana Property Tax (land & improvements)	$10,000	$740,000	$1,290,000	$2,060,000	$2,060,000
Montana Property Tax (business equipment)	$80,000	$150,000	$210,000	$290,000	$290,000
Indirect Worker - Commercial Property Tax	$12,998	$23,774	$27,787	$28,017	$25,355
Direct Worker - Commercial Property Tax	$21,549	$44,204	$57,778	$58,445	$57,568
Indirect Workers - Residential Property Tax	$32,419	$59,296	$69,307	$69,880	$63,241
Direct Workers - Residential Property Tax	$45,576	$85,212	$102,036	$103,163	$97,269
Total	**$202,541**	**$1,102,485**	**$1,756,908**	**$3,864,505**	**$5,888,432**
Impact	**$-180,242**	**$302,567**	**$692,771**	**$2,784,479**	**$4,819,535**

†According to MCA 15-1-501 the Montana Metal Mines License Tax is allocated as follows: 57 percent to the state general fund, 2.5 percent to the hard rock mining impact trust account, 8.5 percent to the hard rock mining reclamation debt service fund, 7.0 percent to the reclamation and development grants program state special revenue account, and 25.0 percent to the county or counties identified as experiencing fiscal and economic impacts.
‡The allocation of the Montana Gross Proceeds Tax, a Class 2 Property Tax, was settled in the early 1990s.
Source: Western Economic Services, LLC 2005.

Based on recently completed permitting and a projected 3-year construction period, the earliest the Rock Creek Project could go into production is late 2010. Mine life of the Rock Creek operation is estimated to be 30 years. Annual earnings from direct and secondary mine-related employment would be about $14 million.

Total peak construction employment demand for the Rock Creek Project would be 345 workers, with a total peak employment demand of 355 employees during operations. The peak population increase associated with Rock Creek development in the Noxon/Heron/Trout Creek area (*i.e.*, western Sanders County) is projected to be about 328 people during project construction. The projected long-term population increase in the Noxon/Heron/Trout Creek area attributable to the Rock Creek Project is estimated to be about 378 people. The total peak population increase in Lincoln County from the Rock Creek Project during operations is estimated to be about 260 people. The vast majority of both positive and negative effects from Rock Creek development would occur in the Noxon/Heron/Trout Creek area.

A key factor determining the number of in-migrating workers for both the Rock Creek Project and the Montanore Project is the fate of the Troy Mine. The Troy Mine resumed operations in 2004 and has an estimated mine life of 6 years. Upon closure of the Troy Mine, a skilled workforce of 150 may be available either to the Rock Creek or Montanore projects. Depending on the timing of each project's start-up, there would be some direct competition for former Troy workers. Because much of the Troy Mine workforce already lives in the Libby area, some of these workers would be expected to seek employment with MMC at Montanore to avoid the longer commuting distance to the Rock Creek Project. Assuming Troy Mine closure and Rock Creek Project startup are relatively concurrent, many current Troy Mine workers would continue employment with Revett for the Rock Creek operation because of employee seniority and benefit vesting in Revett.

With the availability of the Troy Mine workforce for one or both of the new projects and current unemployment rates in Lincoln and Sanders counties, 80 percent local hiring for both projects would be still possible. If only one of the two projects is developed (either Rock Creek or Montanore, but not both), the displaced Troy Mine workforce may provide a substantial amount of the needed workforce. If Rock Creek is developed, but the Montanore Project is not, some Lincoln County residents currently working at the Troy Mine may migrate to Sanders County to shorten their commute.

If the Troy Mine (with additional reserves extending the mine life), Rock Creek, and Montanore were all to operate concurrently, which is considered unlikely based on available current information, the Troy Mine workforce would not be available to the two new projects, and the 80 percent local hiring assumption might not be met. This scenario would result in a larger population migration into Sanders and Lincoln counties than would result from the development of only one project. It also would result in the greatest level of community disruption.

Under the most likely situation, no in-migrating workers directly associated with the proposed Montanore Project are expected to reside in Sanders County. From a standpoint of cumulative impacts, the Montanore Project is not expected to have any direct effect on employment, population, or public services in Sanders County.

3.17.4.4 Regulatory/Forest Plan Consistency

The goal for mineral development in the KFP is to "encourage responsible 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 proposed Montanore Project would be consistent with this goal outlined in the KFP (USDA Forest Service 1987).

3.17.4.5 Irreversible and Irretrievable Commitments

There would an irreversible commitment of mineral resources under all of the action alternatives. Economic productivity for timber or other resources from mined lands would be irretrievable lost during mine operations.

3.17.4.6 Short-term Uses and Long-term Productivity

In the short term, the project would increase costs for cities, schools, and counties through mine-related in-migration and resulting increases in local government service costs. A short-term increase in population, as well as increases wages, spending, and tax revenue would occur over the life of the mine. Over the long term following mining, population and income levels may decline, as would the cost for local governments to provide services.

3.17.4.7 Unavoidable Adverse Environmental Effects

Under the No Action Alternative, local governments would not benefit from project-related revenues from: property taxes on the mine land, plant, and equipment; gross proceeds tax on the value of ore produced; and property tax on new homes and commercial facilities built as a result of mine development. Under all mine and transmission line alternatives, increased employment and population would place increased demands on housing and some public services, including schools, which would result in unavoidable adverse environmental effects.

3.18 Soils and Reclamation

3.18.1 Regulatory Framework

The KFP requires BMPs on National Forest System lands to limit soil erosion and to maintain soil productivity (USDA Forest Service 1987). In addition, chapter 2550 of the Forest Service Manual contains soil management objectives and policies applicable to activities on the KNF (USDA Forest Service 1990). Soil quality standards apply to lands where vegetation and water resource management (*i.e.*, timber sales, grazing pastures or allotments, wildlife habitat, and riparian areas) are the principal objectives. For these activities, the Forest Service Manual states that no more than 15 percent of an activity area may be detrimentally disturbed or if the area has greater than 15 percent disturbance presently there will be a net improvement after the activity is complete (this includes harvesting and site prep activities). This disturbance limit is in place to ensure that timber production can continue following these activities.

Areas on National Forest System lands with intense long-term development (*i.e.*, where the vegetation has been removed) are reallocated to non-timber production management, and lands that are changed in management type do not have to meet the 15 percent disturbance standard. As discussed in sections 2.12, *Forest Plan Amendment* and 3.14, *Land Use*, areas to be reallocated to non-timber production management would include the tailings impoundment, plant site, limited disturbances in LAD Areas, and portions of the transmission line corridor where the vegetation would be removed.

For this proposed project, the KNF emphasizes protection of the soil resources and implementation of restoration practices where necessary on National Forest System lands. Standards and BMPs identified in the KFP would be included as mitigation measures where appropriate and would be used to guide MMC's implementation of this project in respect to soil resources.

On the state level, the MMRA requires that all lands disturbed by mining to be reclaimed to a post-mine land use and be reclaimed to comparable stability and utility. The DEQ must evaluate MMC's proposed reclamation plan for areas to be revegetated to ensure that the soil needed to reclaim mine site disturbances would be salvaged and replaced, and areas revegetated to comparable stability and utility. The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives.

3.18.2 Analysis Area and Methods

The analysis area for soils that would be disturbed by facility construction under each alternative is shown on Figure 81. The Libby Loadout would be in the previously disturbed Kootenai Business Park, and the loadout is not discussed further.

Soil investigations for the mine area facilities and the transmission line corridors were conducted in 1988 and 1989 by Noranda to provide soil information for land use, management, and reclamation (Western Resource Development Corp. 1989b, 1989c). A detailed soil survey using standard USDA soil survey methods was performed in an "intensive study area," which included most of the Little Cherry Creek Tailings Impoundment Site and the Poorman Tailings

Impoundment Site, the Ramsey Plant and Libby Adit sites, and most of the two LAD Areas. The "extensive study area" consisted of the proposed access roads and transmission line corridors. Soils information from the KNF soil survey was used for the extensive study area (USDA Forest Service and Natural Resources Conservation Service 1995).

The soil baseline studies contain descriptions of field, laboratory, and interpretation methods (Western Resource Development Corp. 1989b, 1989c). Laboratory analyses were performed for selected physical and chemical parameters of the soils to assist with making interpretations important to mining operations and reclamation. Particle size analysis, percent rock fragments (> 2mm), organic matter percent, soil pH, and percent water at saturation were determined.

Soil interpretations were made for construction, management, and reclamation purposes. For the intensive survey area, soil erodibility, potential slope stability, and soil suitability were determined for each soil map unit. For the extensive study area, soil erodibility, slope failure, and revegetation potential were obtained from the KNF soil survey. Because the soils data for the extensive study area are more generalized, soil suitability was extrapolated from the intensive study area to provide more probable site-specific salvageable soil volumes.

Soil baseline studies and interpretations were used to access the likely effects for each alternative. Soil suitability was used to determine volumes of salvageable soil to be used for reclamation at each proposed disturbance. Soil erodibility was used to assess the susceptibility of the soils to erode when disturbed and the likelihood of eroded soil reaching stream channels. Slope failure was used to evaluate soil suitability for road construction and maintenance.

3.18.3 Affected Environment

Soils in the analysis area have been influenced by four geomorphic processes: colluvial (movement downhill as a result of gravity); fluvial (movement by flowing water from streams and rivers); glaciolacustrine (movement or deposition in lakes); and glacial (movement by glaciers). In addition to these four processes, a thin mantle of volcanic ash-influenced loess (fine textured soil deposited by wind) blankets much of the analysis area soils. The loess commonly differs sharply from the soil beneath it. The ash-influenced loess generally contains less rock fragments, has a higher moisture-holding capacity, and can be extremely susceptible to erosion.

Within the analysis area, the soils vary in age, degree of development, and fertility. Relatively young soils forming in colluvial material generally have little development, are typically high in rock fragments, and generally are infertile. Soils associated with alluvial processes are also relatively young, have little or no development, have abundant rock fragments, and generally are infertile. Soils forming in glaciolacustrine sediments are of late-Wisconsin glacial age (10,000-25,000 years before present), show weak to strong development, are typically high in silts and clays with few rock fragments, and are relatively fertile to infertile. Other intermediate aged soils have some development, are relatively fertile to infertile, and have some rock fragments. The oldest soils, associated with continental glaciation, are strongly developed, have clay to silty clay textures, and are some of the more fertile soils in the permit area.

3.18.3.1 Soil Types

Soils within the analysis area can be divided into six general groups based on the parent material and the type of geomorphic process in which they formed (Figure 81). The soil group

"colluvial/glacial soils" was mapped only in the intensive study areas; because of the scale of mapping, it is not shown in Figure 81. The six groups are:

- Alluvial soils that formed in rocky alluvium
- Glaciolacustrine soils that formed in fine-textured glaciolacustrine deposits
- Alpine glacial soils that formed in rocky alpine glacial drift
- Continental glacial soils that formed in rocky continental glacial drift
- Residuum/glacial soils that formed in rocky residuum and glacial drift
- Colluvial/glacial soils that formed in rocky colluvium and glacial drift

3.18.3.1.1 Alluvial Soils

The alluvial soils are deep, well drained to very poorly drained, and contain a high amount of rock fragments. They formed in gravelly and cobbly coarse-textured alluvium and have a volcanic ash surface layer. They occur on nearly level to strongly sloping alluvial and glaciofluvial terraces, terrace escarpments, drainage bottoms, old lake beds, and floodplains. These soils are moderately extensive along Poorman, Libby and Bear creeks at the Little Cherry Creek and Poorman Tailings Impoundment sites, the Ramsey Plant Site, the Libby Adit Site, and along the Fisher River valley bottom near the transmission line alignments. Narrow areas of alluvial deposits occur along all streams in the analysis area. Depth to the water table is variable, with some soils saturated most of the year. Included in this soil group within the proposed Little Cherry Creek Tailings Impoundment Site are very poorly drained areas, such as bogs and wet depressions that contain organic-rich soils.

The surface textures are generally loam, gravelly silt loam, and very gravelly sandy loam with 5 to 55 percent rock fragments. Subsoil textures are generally gravelly silt loam, extremely gravelly silt loam, and loamy sand with 15 to 75 percent rock fragments. Rocky colluvial soils occur on many toeslopes within this soil group. Organic matter content is medium to very high (3 percent to greater than 50 percent in some poorly drained areas) in the surface layers and is typically much lower in subsoil layers. The soils are very strongly acid to moderately acid (pH 4.5 to 5.7). Available water holding capacity is low to high, and soil permeability is slow to rapid. Generally, the surface layers of these soils have low to moderate susceptibility to erosion by water and low to high susceptibility below the surface layer. The soils have low to high sediment delivery efficiency, which is the relative probability of eroded soil reaching a stream channel, and they have high slope stability.

3.18.3.1.2 Glaciolacustrine Soils

Glaciolacustrine soils are deep, well drained, and relatively free of rock fragments. They formed in fine-textured glacial lake sediments and have a volcanic ash surface layer. They are found on nearly level to strongly sloping glaciolacustrine terraces and steep to very steep terrace risers. These soils are of moderate extent in the Little Cherry Creek and Poorman Tailings Impoundment sites, and they occur along the transmission line alignments. Included in this soil group within the proposed Little Cherry Creek Tailings Impoundment Site are very poorly drained areas, such as bogs and wet depressions that contain organic-rich soils

The surface textures are generally silt loam with few rock fragments. Subsoil textures are generally silt loam, silty clay loam, and silty clay with few rock fragments. Clay contents in subsoil layers can exceed 45 percent. Organic matter content is medium (2 to 3 percent) in the

surface layers and is typically less than 1 percent below the surface layer. The soils are strongly acid to slightly acid (pH 5.4 to 6.2). Available water holding capacity is high, and soil permeability is very slow. Generally, the surface layers of these soils have moderate to high susceptibility to erosion by water and high susceptibility below the surface layer. The soils have low to moderate sediment delivery efficiency. They generally have high slope stability, but exhibit cutbank sloughing on slopes greater than 15 percent.

3.18.3.1.3 Alpine Glacial Soils

Alpine glacial soils are deep, well drained, and contain a large percentage of rock fragments. They formed in gravelly, medium-textured glacial drift and have a surface layer of volcanic ash. They occur at higher elevations on gently to steep glacial moraines and glacial valleys. In places, rock outcrops are extensive within this soil group. These soils are moderately extensive in the valleys at the Ramsey Plant Site, Libby Adit Site, Rock Lake Ventilation Adit, and along the transmission line alignments.

The surface textures are generally gravelly silt loam with about 20 percent rock fragments. Subsoil textures are generally very gravelly silt loam with 40 to 60 percent rock fragments. Organic matter content can be very high in the surface layer due to ash influence, but drops off rapidly to less than 1 percent a few feet below the surface. The soils are generally very strongly acid to strongly acid (pH 5.0 to 5.5). Available water holding capacity is moderate, and soil permeability is moderate to high. Generally, both the surface and subsurface layers have moderate to high susceptibility to erosion by water. The soils have low to high sediment delivery efficiency. They are commonly susceptible to cutbank sloughing and raveling.

3.18.3.1.4 Continental Glacial Soils

Continental glacial soils are deep, well drained, and rocky. They formed in gravelly, fine-textured old glacial drift and have volcanic ash surface horizons. Some soils in this group formed in rocky colluvium. This soil group, which is at lower elevations than the alpine glacial soils, occurs on nearly level to very steep, continentally glaciated plains, mountain side slopes, and ridges. In places, rock outcrops are extensive within this soil group. These soils are very extensive along the transmission line alignments, at the Little Cherry Creek and Poorman Tailings Impoundment sites, making up over half of the impoundment sites, and most of the Libby Plant Site and LAD Areas. Included in this soil group within the proposed tailings impoundment sites are very poorly drained areas, such as bogs and wet depressions that contain organic-rich soils.

The surface textures are generally silt loam, gravelly silt loam, and clay loam with few to 30 percent rock fragments. Subsoil textures are generally very gravelly, moderately fine and fine textures with 10 to 60 percent rock fragments. Clay contents can exceed 60 percent in the subsoil. Organic matter content is medium to high (2 to 5 percent) in the surface layer, but decreases to less than 1 percent below the surface. The soils are generally very strongly acid to moderately acid (pH 4.7 to 5.9) but can be mildly alkaline in the substratum. Available water holding capacity is moderate to high, and soil permeability is very slow to slow. Generally, both the surface and subsurface layers of these soils have moderate to high susceptibility to erosion by water. The soils have low to high sediment delivery efficiency. They are commonly susceptible to cutbank sloughing and landslides can occur in steep drainageways.

3.18.3.1.5 Residuum/Glacial Soils

Residuum/glacial soils are shallow to deep, well drained, and contain a high amount of rock fragments. They formed in gravelly medium textured glacial drift and meta-sedimentary residuum

and have a volcanic ash surface layer. They occur on gently sloping to very steep glacial scoured ridge tops, glacial trough walls, and valley side slopes. They are moderately extensive in the Little Cherry Creek and Poorman Tailings Impoundment sites, and they occur along the transmission line alignments.

The surface textures are generally silt loam and gravelly silt loam with few to 30 percent rock fragments. Subsoil textures are generally very gravelly loam with up to 60 percent rock fragments. Rock outcrops occur throughout these soils. Organic matter content is moderately low in the surface layer and low below the surface. The soils are generally very strongly acid to moderately acid (pH 5.2 to 6.0). Available water holding capacity is low, and soil permeability is moderate to rapid. Generally, the surface layers of these soils have moderate susceptibility to erosion by water, and have low susceptibility to erosion by water below the surface layer. These soils have low to high sediment delivery efficiency. They commonly exhibit high slope stability but landslides can occur in steep drainageways, and sloughing and raveling can occur if cutbanks are steep. Avalanche paths occur on some very steep slopes.

3.18.3.1.6 Colluvial/Glacial Soils

The colluvial/glacial soils are moderately deep to deep, well drained, and contain high amounts of rock fragments. They formed in gravelly and cobbly medium textured colluvium and glacial drift and have volcanic ash surface layers. They occur on gently sloping to very steep colluvial and glacial side slopes, ridge tops, in cirque basins (semicircular basins near valley heads in mountains caused by glacial erosion), and in avalanche chutes and debris deposits. These soils are extensive at the Ramsey Plant Site. Several avalanche debris fans are located at the Libby Adit Site.

The surface textures are generally silt loam to extremely gravelly silt loam with 10 to 80 percent rock fragments. Subsoil textures are generally very gravelly silt loam and extremely gravelly loam, silt loam, and sandy loam with 35 to 87 percent rock fragments. Many of these soils have a large amount of stones and boulders covering the surface, and rock outcrops occur as inclusions. Organic matter content is medium to high (3 to 6 percent) in the surface layers and is typically less than 1 to 3 percent in subsoil layers. The soils are strongly acid to slightly acid (pH 5.3 to 6.1) but are extremely acid with a pH of 4.4 in areas at the Libby Adit Site. Available water holding capacity is low to moderate and soil permeability is moderate to rapid. Generally, the surface layers of these soils have low to moderate susceptibility to erosion by water and low susceptibility to erosion by water below the surface layer. The soils have moderate to high sediment delivery efficiency. Generally on shallower slopes (less than 25 to 35 percent), these soils have high slope stability and have moderate to low slope stability on steeper slopes.

3.18.3.2 Suitability for Reclamation

The soils in the analysis area are generally suitable for salvage and replacement. Relatively organic-rich surface layers range from 5 to 29 inches thick and average about 10 inches thick. Subsoils are also suitable for salvage and use in reclamation. Salvageable soil, including both surface soil and subsoil layers, ranges from 9 to 33 inches. Organic matter levels in surface soils are generally moderate to high, and pH values range from 4.4 to 6.6, but are typically between 5 and 6. Because of volcanic ash, the surface layers are typically medium textured and have a high water holding capacity. Some surface layers of colluvial/glacial soils have a moderate water holding capacity. A high water table would preclude salvage of some alluvial soils. Soils on

slopes greater than 50 percent are considered unsuitable for salvage per DEQ soil salvage guidelines.

The primary limitation to soil suitability for reclamation is rock fragment content. Soils with more than 50 percent rock fragments are generally considered unsuitable per DEQ guidelines, unless they are needed to control erosion on steep slopes. Surface soils commonly have 10 to 50 percent rock fragments, but glaciolacustrine surface layers are relatively free of rock fragments. Many of the colluvial/glacial soils contain high amounts of stones and boulders on the surface. Salvageable soils with stones and boulders would require special handling. Subsoil layers are more variable in texture and pH, but generally have high amounts of rock fragments, except for glaciolacustrine subsoil layers, which generally lack rock fragments. The soils are rated good to poor for road suitability. Poor ratings are typically due to steep slopes and susceptibility of slope failure. Glaciolacustrine soils are rated poor for road suitability due to slumping, and some alluvial soils are rated poor due to excess water. None of the soils in the analysis area have severe reclamation constraints.

3.18.4 Environmental Consequences

This section addresses soil impacts resulting from the action Alternatives 2, 3, and 4. The impacts are typical of any operation where soil would be removed, stored, and replaced. First, the effects to soils that would be common to all action alternatives are presented followed by the effects to soils that would be unique to each alternative. Soil impacts resulting from all action alternatives would include:

1) Soil loss from erosion of disturbed areas and losses of salvageable materials through erosion and handling

2) Changes in soil physical, chemical, and biological characteristics

3) Reduction in plant growth due to potentially harmful metals in some subsoils because of the acid pH levels and in mine wastes that would be part of the revegetated plant community rooting zone

These impacts, combined with the project's reclamation plan, determine in part, the potential success of reclaiming the land to forest cover and wildlife habitat after operations ceased. Limited reclamation success, in turn, may result in secondary or long-term negative impacts including soil erosion, sedimentation to streams, reduced soil/site productivity, and visual deterioration.

3.18.4.1 Effects Common to All Action Alternatives

3.18.4.1.1 Soil Loss

Areas cleared of vegetation would be susceptible to erosive forces and soil loss. Loss of soil also would occur from the removal and storage of soils during mine operations and from erosion of exposed soils during reclamation and stabilization. Soil erosion caused by wind or water likely would occur during all phases of the project. Initial erosion rates would be moderate to high due to soil exposure, slope steepness, and precipitation patterns. Soil losses on undisturbed lands in northwestern Montana are commonly less than 2 tons/acre/year, but under all action alternatives, soil loss rates would likely exceed 2 tons/acre/year on all disturbed areas until vegetation was established and roads were chip sealed or graveled. Following reclamation, soil losses of less than 2 tons/acre/year are typically needed for successful revegetation. Native plant communities

typically take 3 to 5 years to establish, and longer on steep slopes and road cuts, especially on south- and west facing slopes.

Losses of soil at disturbances, such as Ramsey and Libby Plant Sites, Libby Adit Site, Little Cherry Creek and Poorman Tailings Impoundment sites, and soil stockpiles would be captured by sediment control BMPs. Soil losses at soil stockpiles also would be controlled by installing berms around the stockpiles.

Soil losses would occur at cut-and-fill slopes at the plant sites, at mine and transmission line access roads, and at staging areas. Fill slopes would be particularly susceptible to failure, and difficult to revegetate, and cut-and-fill slope raveling (movement of dry soils) may be difficult to control in some locations. Construction of new roads and upgrading of existing roads would cross areas where soils have a severe erosion risk, high sediment delivery potential to enter waterways, and potential for slope failure. Some roads would be reclaimed as work progressed, so surface erosion would be limited. Road-building in steep terrain typically results in accelerated erosion and sedimentation (Megahan and Kidd 1972 *In* USDA Forest Service and DEQ 2001; Packer 1966 *In* USDA Forest Service and DEQ 2001). Increases would be highest within the first 2 years, but erosion may continue for long periods depending on site conditions. Because precipitation is high in the area, cut-and-fill slopes would be immediately stabilized to reduce potential erosion.

Road cut-and-fill slopes and other disturbances along roads would be seeded, fertilized, and stabilized with hydromulch, netting, or by other methods as soon as final grades are achieved after construction to minimize erosion and to avoid crusting of the soil surface. Soil crusting would reduce seed establishment and water infiltration and result in more runoff and erosion. Following construction of the transmission line, interim reclamation (removal of drainage obstructions at road crossings, replacement of soil where it was removed and reseed) would be used on transmission line access roads placed into intermittent stored service to stabilize the surface and reduce erosion. Erosion from the transportation system would increase during and after (for up to 5 years but possibly more on south- and west-facing cut slopes) construction and reconstruction until cut-and-fill slopes were stabilized. All new roads would be decommissioned at the end of operations when no longer needed and most other currently existing roads would be reclaimed to preoperational conditions. Some roads would be covered by the tailings impoundment in all mine action alternatives.

Unprotected road surfaces would be susceptible to erosion. Access roads operational for mine life would be chip sealed or graveled, which would reduce potential erosion, and BMPs would be used to control drainage from road surfaces. For existing roads needing upgrading, sediment controls would be upgraded/installed and appropriate BMPs would be implemented, which in the long run, would reduce soil loss from existing road corridors.

Erosion would occur during reclamation activities when salvaged soils are spread on recontoured surfaces. Areas reclaimed using direct-hauled soils (a reclamation technique whereby soil is stripped from an undisturbed area and immediately placed on a disturbed area that has been prepared for reclamation), such as road cut-and-fill slopes and in places at the Little Cherry Creek and Poorman Tailings Impoundment sites, would have less potential for erosion than areas reclaimed with stored soil. Protective vegetation would establish more quickly because direct-haul soils are still biologically active and retain a higher level of favorable physical and chemical characteristics than soils stored for prolonged periods. Only a small, undetermined percentage of

the total volume proposed for salvage would be direct-handled because of the timing difference between construction and reclamation.

Wind erosion of exposed soil also would contribute to soil losses. To minimize soil wind erosion, MMC would use standard BMPs, such as periodic watering of unpaved roads and disturbed surfaces, and use of mulch and tackifiers on exposed surfaces until vegetation was established.

Soil losses would occur under all action alternatives, and even with erosion and sediment control BMPs, some sedimentation is expected in waterways down gradient of disturbances. Soil losses generally would be long-term within all disturbed areas, because erosion rates would remain elevated after reclamation until the vegetation ground cover approaches predisturbance levels in 3 to 5 years. South- and west-facing cut slopes may require more than 5 years for the vegetation ground cover to reach predisturbance levels without soil amendments. Once vegetation was well established, soil losses would be similar to pre-mine rates.

3.18.4.1.2 Soil Physical, Biological, and Chemical Characteristics

Soil characteristics that would be impacted by all action alternatives would include potential changes in soil physical and chemical properties, biological activity, and nutrient levels. Soil structure would be altered by handling, salvage, and storage operations. Changes in chemical properties such as heavy metal concentrations and soil pH may also occur at the mine facilities. These changes to the soil characteristics are discussed below.

Physical Characteristics

Changes in physical properties of the soils due to handling, salvage, and storage would result in the alteration of the natural soil profile that has developed since the last major soil disturbing event such as glacial activity, volcanic ash deposition, or flooding. This would be an unavoidable impact of salvaging and replacing soils. Some of these areas have been logged in the past, which disturbed the surface soil profile but not to the extent that mining disturbance would. Soil structure, compaction (destruction of pore space continuity and soil structure), and loss of organic matter due to mixing and storage would occur. Soils salvaged and replaced in a single lift would alter the natural soil profile due to mixing of soil horizons, which would be a long-term impact. Two-lift salvage and replacement is proposed in the tailings impoundment areas that would limit some of the mixing across soil horizons, but the impacts would still be long term. The establishment of vegetation, root systems, and physical processes, such as freezing and thawing, and wetting and drying, would restart the soil-building processes and help rebuild the natural soil profile, but this would require a long time.

Compaction from heavy equipment would adversely affect soil plant relations due to decreased soil water-holding capacity, loss of aeration and pore space, and increased soil bulk density (Sharma 1996 *In* USDA Forest Service and Montana DEQ 2001). Coarse-grained soils and fine-grained matrix soils that have a large volume of rock fragment, may or may not be as affected, depending on the overall soil composition (Sowers 1979 *In* USDA Forest Service and DEQ 2001).

The volcanic ash component of many of the surface soils proposed for salvage may provide some resistance to severe compaction caused by equipment operation and the sheer weight of the stockpiles. Volcanic ash-influenced soils in northwest Montana have lower initial bulk densities than soils derived from other sources. When disturbed during activities that use heavy equipment (such as logging), these soils would compact but not as severely as other soils (Kuennen *et al.*

1979 *In* USDA Forest Service and DEQ 2001). The reasons for this are not well understood, but they appear to relate to the porous nature of ash particles, how they naturally aggregate, and how they interact with organic matter (Harwood and Youngberg 1969 *In* USDA Forest Service and DEQ 2001; Nimlos 1981 *In* USDA Forest Service and DEQ 2001). Additionally, studies have not explored the behavior of ash-influenced soils under prolonged storage in deep piles; therefore, it is not possible to quantify the potential resistance to compaction of these soils.

Fine-textured glaciolacustrine subsoils are susceptible to compaction during the soil salvage process and have lower inherent infiltration and permeability. Non-glaciolacustrine soils in the area would not be as susceptible to this compaction because they often have greater sand and rock fragment contents.

To reduce compaction, severely compacted areas, such as roads, soil stockpile sites, and facility sites, would be ripped prior to soil placement, and seedbeds would be disked and harrowed prior to seeding. Soil compaction would be short-term in all disturbed areas with these mitigation measures, and following reclamation compaction in respread soils that are ripped would be similar to pre-mine soils.

Biological Activities

Biological changes would occur in salvaged soils. Since most disturbances would not be reclaimed until the end of operations, most salvaged soils would be stockpiled for 15 years or more. Soils salvaged along transmission line roads would be respread within a year. Prolonged storage decreases or eliminates populations of important soil microorganisms (Miller and Cameron 1976 *In* USDA Forest Service and DEQ 2001), such as bacteria, fungi, and algae, which are essential in soil nutrient cycling. In addition, some favorable components normally found in native soils are lost through decomposition during storage. These components include seeds of native plants, rhizomes (underground stems), and other plant parts capable of producing new plants. Replenishment of soil microorganisms would occur with interim revegetation of soil stockpiles but would be limited to the surface (the top 6 to 8 inches) of the stockpile. Most stockpiled soil would have reduced biological activity.

Mycorrhizae (important structures that develop when certain fungi and plant roots form a mutually beneficial relationship) are also eliminated in soil stored for prolonged periods. Mycorrhizae serve as highly efficient extensions of plant root systems, especially for woody species. These associations are important to consider in maximizing plant establishment and productivity because most plants depend on mycorrhizae for adequate growth and survival (Mallock *et al.* 1980 *In* USDA Forest Service and DEQ 2001; Trappe 1981, *In* USDA Forest Service and DEQ 2001). This is especially true in nutrient deficient soils. All of the salvaged soils are relatively infertile. Mycorrhizae are particularly important to plant phosphorus nutrition and water uptake (Christiansen and Allen 1980 *In* USDA Forest Service and DEQ 2001). Thus, the association of mycorrhizae with plants in the study area is especially critical because plant-available phosphorus is expected to be low.

Chemical Characteristics

Aluminum, iron, and manganese are found in native forested soils in the area. These common metals are released by the weathering of soil parent materials, even in non-mineralized areas. They can become concentrated in a particular soil horizon by various soil-formation processes. Although typically not available to plants at neutral pH values, if soil surveys indicate soil pH is around 5.0, the agencies would require soil metal testing to identify possible naturally occurring

concentrations of these and other metals. Soil samples tested had pH values from 4.3 to 7.5, with values between 5.0 and 6.0 being the most common. Samples with low pH were generally from the Little Cherry Creek and Poorman Tailings Impoundment sites, but soils with low pH potentially occur at all proposed disturbance areas. Soils having pH conditions below 5 are not proposed to be salvaged. Aluminum in particular may be slightly elevated in volcanic ash-rich loess. Elevated aluminum levels are common in forested soils of northwest Montana, and native vegetation likely has adapted to the ambient soil chemistry.

Heavy metals often associated with mineralized zones, such as lead and copper could hinder plant growth. None of the rock types tested during exploration and past mining operations exhibited highly elevated leachable metal concentrations, which are metals that would become soluble in soil water (see section 3.8, *Geology* for detailed discussion of leachable metals). Preliminary testing shows tailings materials and some of the mine waste rock would have low levels of leachable metals and no net acid generation potential. Considering these results, the mine waste materials would have limited adverse chemical impacts on respread soil or on plants whose roots may grow into these materials in the lower part of the rooting zone. MMC would test waste rock and tailings prior to soil redistribution to reconfirm these results.

3.18.4.1.3 Reclamation Success

Recognition of inherent soil properties and design of salvage programs to retain favorable properties can enhance reclamation success. Soil characteristics important to consider for analyzing impacts and assessing soil salvageability and suitability for reclamation include:

- depth and horizon (developed soil layer) sequence
- texture (relative proportion of sand-, silt-, and clay-sized particles)
- coarse fragment content (size, amount, and shape (rounded or angular))
- erodibility
- organic matter content
- reaction (refers to the acidity or alkalinity of the soil solution and is expressed as pH ranging from 1 to 13, where 1 is the most acidic, 7 is neutral, and 13 is most alkaline or basic)
- slope steepness; and location and extent of rock outcrop and talus

Soil Salvage and Handling

The potential for reclamation success of disturbed lands is greatly improved when soil is salvaged and later replaced as a growth medium for plants. MMC would salvage and replace soils on most disturbed areas, except where slopes are too steep, at soil stockpile areas, and where soils are too rocky. The primary limitations that affect soil suitability for salvage and reclamation at the site include rock content and steep slopes, and to a lesser extent, soil texture, soil pH, and a high water table. Salvage may be limited for soils with a volume of more than 50 percent rock fragments (larger than 1/16 inch diameter) or with large rocks (greater than 2 feet in diameter). Soils with up to 60 percent rock fragments would be salvaged in some areas to provide erosion protection on the steep embankment of the Little Cherry Creek and Poorman Tailings Impoundment sites. Salvage would not be required and not be conducted on slopes exceeding 2:1 (50 percent) because of worker safety considerations. Other reclamation limitations at the site include soils with high clay content and pH levels below 5.

Soil Amendments

Reclamation success can be enhanced on particular sites by use of soil amendments. Use of mulches and tackifiers can limit soil loss until seedlings can establish. Alkaline amendments can be added to acid soils to raise the pH. Wood based organic amendments can be added to the surface soil to increase organic matter contents, reduce compaction, increase soil fertility, and enhance establishment of a fungal based mycorrhizae community that would enhance the establishment and growth of woody plant species. MMC has only proposed the use of mulches to reduce soil erosion.

Revegetation

The main factors relating to revegetation include scheduling of final revegetation, species selection, planting plans, and establishing success criteria to achieve long-term plant cover and density objectives. These factors determine the speed and success of reclaiming the disturbed lands to comparable stability and utility.

MMC would not implement final reclamation for most disturbances until the post-operational phase (after 15 to 20 years). Final reclamation would be done on some sites during the predevelopment period (1 to 3 years). These areas would include the Little Cherry Creek Diversion Channel (Alternatives 2 and 4), cut-and-fill slopes at plant sites, portal patio faces, and the Bear Creek access road north of the proposed Little Cherry Creek Tailings Impoundment. Disturbances reclaimed during operations would include some temporary access roads. Interim reclamation, (replacing soil where it was removed and reseeding) would occur on transmission line access roads placed into intermittent stored service. All other disturbances would be reclaimed after operations cease.

3.18.4.2 Soil Loss

3.18.4.2.1 Alternative 1 – No Mine

Under Alternative 1, the Montanore Project would not be developed. Soil resource impacts would be limited in comparison to the other alternatives. Soil loss due to erosion would be restricted to existing exploration-related or baseline data collection disturbances. All existing soil disturbances by MMC would be reclaimed in accordance with existing laws and permits. Erosion and sedimentation would occur at existing rates along NFS road #278 and other existing roads. Soil erosion losses due to rainfall, runoff, and wind would continue at natural rates at other locations in the analysis area.

3.18.4.2.2 Alternative 2 – MMC's Proposed Mine

Soil losses would occur during construction of access roads and facilities, at soil stockpiles, and when soils are salvaged and respread. Table 133 presents a comparison of the likely disturbances in which soil would be salvaged and salvageable soil volumes of mine facilities for each alternative. The disturbance acres in Table 133 do not include proposed soil stockpiles and existing roads because no soil would be salvaged from these areas. Soil would be salvaged from only small portions of LAD Areas such as roads and ponds. The Libby Adit Site is an existing disturbance area, and soil has already been salvaged and stockpiled at the site, so it is not included in Table 133. The soil loss impacts described below are specific to Alternative 2.

Table 133. Comparison of Disturbances from Soil Salvage and Salvageable Soil for Alternatives.

Disturbance	Units	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment Alternative	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative
Tailings Impoundment/Dam[†]	Acre	620	608	620
Lift 1	cy	754,166	715,500	754,166
Lift 2	cy	1,224,076	1,306,500	1,224,076
Seepage Collection Pond	Acre	8	18	8
Lift 1	cy	8,927	18,042	8,927
Lift 2	cy	20,167	38,992	20,167
Borrow Areas outside tailings impoundment	Acre	419	92	252
Lift 1	cy	393,690	117,464	317,249
Lift 2	cy	393,690	85,305	249,895
Diversion Channel	Acre	40	0	40
Lift 1	cy	50,780	0	50,780
Lift 2	cy	0	0	18,486
Other potential disturbances[‡]	Acre	788	597	629
Lift 1	cy	979,737	736,944	771,967
Lift 2	cy	1,280,675	824,050	1,182,178
Plant Site	Acre	52	104[§]	104[§]
Lift 1	cy	126,000	135,722	135,722
Upper Libby Adit	Acre	0	1	1
Lift 1	cy	0	538	538
LAD Areas	Acre	31	16	16
Lift 1	cy	37,739	19,723	19,723
Lift 2	cy	0	7,663	7,663
Roads	Acre	149	135	135
Lift 1	cy	333,973	151,371	151,116
Lift 2	cy	0	172,699	162,543
TOTAL	Acre	2,107	1,567	1,805
Lift 1	cy	2,685,012	1,902,551	2,210,188
Lift 2	cy	2,918,608	2,448,213	2,865,008

[†] Entire tailings impoundment areas also include Seepage Collection Pond, borrow areas outside tailings impoundment footprint, Diversion Channel (Alternatives 2 and 4), and other potential disturbances.
[‡]Includes roads, storage areas, ditches, pipelines, etc. Does not include soil stockpiles and existing roads.
[§]Soils not mapped at intensive level, suitable lift-2 soils likely present; does not include soil stockpile areas and existing roads; acreage may differ from disturbance acres presented in Table 5 for Alternative 2, Table 14 for Alternative 3, and Table 29 for Alternative 4 in Chapter 2.
cy = cubic yard.
Source: GIS analysis by ERO Resources Corp. using soils mapping in Western Resource Development Corp. 1989b, 1989c.

Alternative 2 - Soil Losses from Construction of Facilities and Roads

Construction of mine related facilities and roads would result in soil disturbance and a loss of soil productivity on about 2,107 acres (Table 1). Much of the facility disturbances would be covered with structures, such as buildings, or other material, such as tailings and waste rock.

New roads, upgrading existing roads, and pipeline corridors would result in a total disturbance area of 149 acres. Unprotected road surfaces would be susceptible to erosion. For access roads operational for mine life, MMC would chip seal or gravel road surfaces, which would reduce potential erosion, and BMPs would be used to control drainage from road surfaces. For existing roads needing upgrading, MMC proposes to upgrade/install sediment control and implement appropriate BMPs, which in the long run, may reduce total soil loss.

Areas of culvert replacement and/or extension and bridge construction at Ramsey Creek and Poorman Creek would be subject to erosion until stabilized. Short-term increases in sedimentation may occur as a result.

MMC proposed a 10,800-foot Little Cherry Creek Diversion Channel around the tailings impoundment that would flow into Libby Creek. The Diversion Channel would consist of two main sections: an upper engineered channel (designed for the 6-hour Probable Maximum Flood flow and the riprapped channel sides for the 100-year flood flows), and two existing natural drainage channels tributary to Libby Creek (Figure 8). Both tributary channels would receive flow from the Upper Diversion Channel, which would reduce channel impacts that can occur during peak flow events. The lower tributaries are not large enough to handle the expected flow volumes; these tributaries would undergo channel adjustments until they stabilized. These adjustments would include bank erosion, channel scouring, and sloughing of bank material, which would contribute sediments to Libby Creek.

MMC would construct some bioengineering and structural features based on need and access in the two unnamed tributary channels to reduce flow velocities, minimize erosion in the unnamed tributaries, minimize sedimentation to Libby Creek, and create fish habitat. In addition, MMC would evaluate potential locations for creating wetlands and ponds in low gradient areas to capture and retain most of the sediments generated from the unnamed tributaries and minimize sedimentation to Libby Creek. If wetlands or ponds were not constructed to retain mobilized sediments on the Libby Creek floodplain, the additional input of sediments to Libby Creek may cause channel aggradation, which may result in bank erosion due to channel widening. Bank erosion in the unnamed tributaries and possibly sedimentation to Libby Creek would continue until the tributaries adjusted to the increased flow volumes (see section 3.6, *Aquatic Life and Fisheries*). If substantial erosion occurred once the diversion channel was operational, additional erosion control structures would be constructed as needed.

Once the tailings impoundment was reclaimed, there would be a slight increase in flow to Bear Creek from runoff from the impoundment surface. This runoff would flow to Bear Creek via a diversion ditch. The ditch would be riprapped to minimize erosion and sedimentation in Bear Creek. A small rockfill check dam would be located just beyond the northwest end of the reclaimed impoundment. If necessary, sediment would be removed from the pond. The check dam would be designed for the 100-year flood event. Short-term erosion in the ditch and subsequent sedimentation in Bear Creek would likely occur during construction of the ditch and check dam. With the additional flow, especially after large runoff events, there could be minor adjustments to the Bear Creek channel resulting in minor scouring and bank erosion.

Alternative 2 - Soil Losses at Soil Stockpiles

All soil stockpiles would be susceptible to erosion. Soil stockpiles would be constructed with 40 percent side slopes and 33 percent sloping ramps where possible. MMC proposes to stabilize stockpiles when they reach their design capacity and seed during the first appropriate season following stockpiling. This would leave exposed soil on steep slopes for potentially prolonged periods. If left exposed and unprotected for more than a couple of months, regardless of other characteristics, large amounts of soil may erode. To minimize sedimentation to floodplains, wetlands and streams, MMC proposes to locate soil stockpiles on gentle slopes away from drainages, install berms around stockpiles, and construct sediment traps downslope of soil stockpiles where necessary.

Apart from erosion resulting from steep slopes and exposure, each stockpile would have a different potential for erodibility. Each stockpile includes soils from adjacent or nearby salvage areas, thus the nature of each stockpile would be different in terms of soil texture and rock content. For example, soils at the Ramsey Plant Site would be salvaged in one lift and would be composed of predominately silt loam with lesser amounts of gravelly silt loam and very gravelly silt loam. Due to the high silt content and only some soils having high gravel content, these stored soils would have a moderate to high erodibility potential. Some soils at the Little Cherry Creek Tailings Impoundment Site would be salvaged in two lifts and stored separately. The surface lift, which includes the more suitable soil, would be comprised of fine-textured volcanic ash, silt loam, gravelly silt loam, and gravelly loam. First lift stockpiles would have moderate to high erodibility potential due to the high silt content and low rock fragment content. The second lift would be composed of gravelly to very gravelly loam and clay loam. Second-lift stockpiles would have moderate erodibility potential due to higher rock fragment content and less silt.

For new roads that are to be operational for mine life, MMC proposes to stockpile soils along the entire corridor. Most of these soils have a volcanic ash surface layer and have a moderate to high erodibility potential due to the high silt content and low rock fragment content. Stockpiling soils along entire corridors would increase the surface area of exposed soil and thereby result in more soil losses than if salvaged soils were concentrated in only a few stockpiles in clearings or areas of recent timber harvest immediately adjacent to new roads.

Alternative 2 - Soil Losses from Soil Salvage and Replacement

Soil losses during salvage and replacement activities could affect the volume of soil estimated for salvage, particularly at LAD Areas and at the Libby Adit Site where salvageable soil was limited (soils have already been salvaged and stockpiled at the Libby Adit Site). This in turn would affect proposed redistribution depths at LAD Areas and at the Libby Adit Site and could potentially adversely affect reclamation success. MMC reports that previous reclaimed disturbances with less than 18 inches of respread soil at the Libby Adit Site have demonstrated viable vegetation cover, and MMC proposes to respread 18 inches of soil at disturbances in LAD Areas requiring soil replacement.

MMC proposes to store all first-lift soils salvaged from the Little Cherry Creek Tailings Impoundment Site together, including surface soils having no or few rock fragments and high erosion potential, such as glaciolacustrine soils, with surface soils having a large amount of rock fragments. This could result in having highly erosive soils on the steep surface of the embankment of the impoundment and lead to excessive erosion of surface soils exposing less fertile subsoil and affecting long-term reclamation success on the impoundment embankment.

MMC proposes to salvage some clay-rich glaciolacustrine subsoils (>40 percent clay) at the Little Cherry Creek Tailings Impoundment Site. This soil type is poorly suited as a plant growth medium due to shrinking and swelling, surface crusting, low water infiltration, slow permeability, and high erodibility potential. If salvaged, this soil could be used as subsoil (9 to 18 inches) on top of the impoundment, or used to cover any sandy or gravelly soils exposed during impoundment site stripping and borrow excavation operations to minimize seepage from the tailings impoundment or from the Seepage Collection Pond, or to line the channel foundation for the Little Cherry Creek Diversion Channel. If this clay-rich material were used as final respread surface soil, plant re-establishment would be impeded and erosion would likely increase, especially on the tailings embankment.

In summary, MMC's proposed measures to control runoff and sedimentation and combined with some of the native surface soil and subsoil characteristics, such as rock fragment content, would help reduce erosion rates. If glaciolacustrine soils were used as surface soil on the impoundment, soil losses could affect reclamation success in the long term especially on the embankment of the impoundment for reasons discussed previously. Until vegetation ground cover reached predisturbance levels, anticipated to be in 3 to 5 years in most areas, erosion rates would be higher than before disturbance. Soil losses are not expected to affect reclamation success at other disturbances, because sufficient soil material exists to meet MMC's proposed reclamation plan, with the possible exception at LAD Areas and at the Libby Adit Site where salvageable soil was limited.

3.18.4.2.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would result in a loss of soil productivity on about 1,567 acres where soil would be salvaged. When compared to Alternative 2, Alternative 3 would result in an overall decrease in soil disturbance by 540 acres, which would include a decrease in road and pipeline disturbances by 14 acres. In addition to the fewer disturbed acres, Alternative 3 also would provide additional mitigation measures that would result in less erosion and less sedimentation to Libby Creek and its tributaries. These additional measures are described below.

On all soil stockpiles, interim seeding and mulching would be conducted incrementally as the stockpiles are being constructed and as soon as possible, regardless of season, rather than waiting until the first appropriate season after they reach design capacity. This would reduce erosion potential and potentially reduce sedimentation to drainageways.

For new roads that are to be operational for mine life, salvaged soils would be stockpiled in clearings or in areas of recent timber harvest immediately adjacent to new roads or in other nearby soil stockpiles rather than stockpiling along the entire road corridor. Consolidating soil stockpiles would improve management and control soil losses along road corridors and minimize sedimentation to nearby waterways. MMC would develop and implement a Road Management Plan addressing all roads used in the alternative. Successful implementation of the plan would ensure that erosion and sediment delivery from roads would be minimized.

A Little Cherry Creek Diversion Channel would not be needed under Alternative 3. Elimination of the Diversion Channel would reduce short-term erosion in the unnamed tributaries and sedimentation to Libby Creek. The potential long-term effects of channel aggradation and bank erosion from channel widening in Libby Creek and the potential for sedimentation and bank erosion in Bear Creek also would be eliminated. Once the tailings impoundment was reclaimed, there would be a 40 to 70 percent increase in average annual flows in Little Cherry Creek as

runoff from the impoundment surface would be directed to Little Cherry Creek. This increase in flow would cause some short-term scouring and bank sloughing in Little Cherry Creek closer to the impoundment and some sedimentation farther downstream.

For soil salvage at the Poorman Tailings Impoundment Site, rocky soil would be segregated from non-rocky soil. Soil would be replaced in two lifts 24 inches thick on the embankment and impoundment surface. Rocky subsoil would be used as respread subsoil (15 inches thick) over the tailings embankment, and rocky surface soil would be used as the upper 9 inches of respread soil on the embankment. This would minimize erosion potential on the embankment. The non-rocky surface soil would be used as the upper 9 inches of respread soil on the rest of the impoundment on slopes less than 8 percent. The clay-rich subsoil of glaciolacustrine soils salvaged from the impoundment area would be stockpiled separately from other second-lift soils and used, along with other salvaged soil, as respread subsoil (15 inches thick) on top of the tailings impoundment. It could also be used to cover any sandy or gravelly soils exposed during impoundment site stripping and borrow excavation operations to minimize infiltration of water from the tailings impoundment or from the Seepage Collection Pond.

With the modifications to control erosion under Alternative 3, soil losses within the disturbed areas would be less and not as severe as under Alternative 2 and sedimentation to waterways would be less for Alternative 3 than for Alternative 2 (section 3.18.4.2.2, *Alternative 2 – MMC's Proposed Mine*). Because there would be 571 fewer acres of soil disturbance in Alternative 3 than in Alternative 2, there would be less soil loss with Alternative 3.

3.18.4.2.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would result in 1,805 acres of potential soil disturbances at soil salvage areas (Table 133). When compared to Alternative 2, Alternative 4 would have 302 acres less soil disturbance, including 14 acres less road and pipeline disturbance (Table 133). When compared to Alternative 3, Alternative 4 would have 238 acres more of soil disturbance (Table 133). Alternative 4 would provide the same additional mitigation measures as Alternative 3, which would result in less erosion and less sedimentation to Libby Creek and its affected tributaries. MMC would develop and implement a Road Management Plan addressing all roads used in the alternative. Successful implementation of the plan would ensure that erosion and sediment delivery from roads would be minimized.

Under Alternative 4, a Little Cherry Creek Diversion Channel would be built and would consist of two main sections: an upper engineered channel and a constructed lower channel to Libby Creek using Channel A proposed in Alternative 2. The engineered channel would be the same as the engineered channel under Alternative 2 and would be designed for the 6-hour Probable Maximum Flood. It would flow into a constructed channel that would be designed to be geomorphologically stable and to handle the 2-year flow event. The natural-designed channel would have similar channel pattern, dimensions, profile, and bed material as similar sized channels in the analysis area (see design elements listed in section 2.6.2.2, *Modified Little Cherry Creek Tailings Impoundment*). A floodplain would be constructed along the channel to allow passage of the 100-year flow.

Significant erosion and sedimentation should not occur because construction of the channel would be done in dry conditions. The majority of sediment generated would occur during initial channel flush and subsequent high flow and rainfall events. In the event of heavy precipitation during construction of the channel, significant erosion may occur. Natural and biodegradable

materials and vegetation would be used along stream banks and on the floodplain to minimize erosion, stabilize the stream channel and floodplain, and minimize sedimentation to the lower channel and Libby Creek. Long-term monitoring and maintenance would be required, if necessary, until the lead agencies determine that the channel was stabilized. Even with these mitigation measures, the constructed natural-designed channel would be subject to erosion and sedimentation during construction and until vegetation stabilizes the stream banks and floodplain. Short-term increases in sedimentation to the lower channel and Libby Creek would likely occur as a result.

Following reclamation of the impoundment, the constructed channel would undergo an additional period of channel adjustment when runoff from the impoundment surface was directed to the Diversion Channel. The increase in flow would be about 50 percent higher than during operations, and would lead to new channel adjustments. This would likely cause short-term increases in sedimentation in the lower channel and Libby Creek.

For soil salvage at the Alternative 4 Little Cherry Creek Tailings Impoundment, rocky surface soil would be segregated from non-rocky surface soil. Like Alternative 3, rocky subsoil would be used as respread subsoil (15 inches thick) over the tailings embankment, and rocky surface soil would be used as the upper 9 inches of respread soil on the embankment. This would minimize erosion potential on the embankment. Non-rocky surface soil would be used as the upper 9 inches of respread soil on the rest of the impoundment on slopes less than 8 percent. Also like Alternative 3, clay-rich subsoil of glaciolacustrine soils salvaged from the impoundment area would be stockpiled separately from other second-lift soils and would be used, along with other salvaged soil, as respread subsoil (15 inches thick) on top of the tailings impoundment. It could also be used to cover any sandy or gravelly soils exposed during impoundment site stripping and borrow excavation operations to minimize infiltration of water from the tailings or from the Seepage Collection Pond, or to line the channel foundation for the Little Cherry Creek Diversion Channel.

With the modifications to control erosion under Alternative 4, soil losses within the disturbed areas would be less and not as severe as Alternative 2 and sedimentation to waterways would be less for Alternative 4 than for Alternative 2 (section 3.18.4.2.2, *Alternative 2 – MMC's Proposed Mine*). Because Alternative 4 would have 302 fewer acres of soil disturbance than Alternative 2, there would be less soil loss under Alternative 4 (Table 133). Compared to Alternative 3, Alternative 4 would have more soil loss because there would be 238 acres more of soil disturbance (Table 133)

3.18.4.2.5 Transmission Line Alternatives

Alternative A – No Transmission Line

Under Alternative A, the transmission line and substation for the Montanore Project would not be built. Soil erosion losses due to water and wind would continue at natural rates. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

Alternative B – North Miller Creek Alternative

MMC's proposed North Miller Creek transmission line corridor would be 16.4 miles long and would require 109 structures. This alternative is slightly longer than the lead agencies' alternatives in part because it ends at the substation at the Ramsey Plant Site where the lead agencies' alternatives end at the substation at the Libby Plant Site about 1.5 miles to the east. Of the four alternatives. The centerline of the transmission line of the North Miller Creek Alternative would cross more steep areas (7.4 miles), more soils with a severe erosion hazard (6.7 miles), and more soils with high sediment delivery (5.1 miles) than the other three alternatives. The disturbance associated with structure placement would increase erosion until vegetation ground cover around the structure locations reached predisturbance vegetation ground cover levels. MMC did not specify the type of logging that would be used. For analysis purposes, the lead agencies assumed all logging would be completed conventionally without the use of a helicopter. Disturbance associated with logging operations would increase soil erosion.

The primary surface disturbance from transmission line construction would be construction of new access roads. The total disturbance for access roads, which would be either new roads or closed roads requiring upgrades, would be greater under this alternative (30.9 acres) than the other alternatives. The access roads would disturb 8.9 acres of soil having severe erosion risk, 6.3 acres of soil having high sediment delivery potential to waterways, 13.3 acres of soil having potential for slope failure, and 16.5 acres of slopes greater than 30 percent (Table 134). Disturbances on steeper slopes are generally more difficult to reclaim and require more mitigation measures than on shallower slopes. The majority of soils having severe erosion risks along access roads occur along Libby and Miller creeks and Fisher River. Most soils with high sediment delivery potential disturbed by access roads occur along Ramsey, Libby, and Miller creeks and Fisher River. Most soils having potential for slope failure occur along Ramsey Creek, just east of Libby Creek, and near Fisher River. Access roads on slopes exceeding 30 percent primarily occur along Ramsey Creek, between Libby and Miller creeks, north of Miller Creek, and locations east of the Fisher River (Figure 82).

Sediment controls and BMPs would be implemented on new and upgraded roads during construction of the transmission line to minimize erosion, sediment delivery to waterways, and slope failure. All access roads, after construction of the transmission line but during the life of the project, would be closed and placed into intermittent stored service and reclaimed with interim reclamation designed to stabilize the surface. This reclamation would include removal of drainage obstructions at road crossings, reseeding the road surface, and where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded.

After the transmission line was removed, all newly constructed roads on National Forest System lands would be decommissioned. They would be recontoured to match existing topography, obliterating the road prism, and reseeded. Where culverts were removed, stream banks would be recontoured and reseeded. Final closure status of new access roads on private lands would be based on the landowner's discretion. With sediment controls, BMPs and short duration of exposed soil, there would be no severe reclamation constraints, no significant adverse impacts to the soil resources, and the soil losses along access roads would likely be minor until vegetation was re-established in most areas after 3 to 5 years. Vegetation re-establishment on steep areas, particularly on south- and west-facing slopes, would take longer.

Table 134. Comparison of Physical Characteristics and Erosion Risks for Transmission Line Alternatives.

Criteria	Units	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Total length of Transmission Line	Miles	16.4	13.4	14.1	14.9
Total road disturbance[†]	Miles	10.2	3.0	3.3	4.2
	Acres	30.9	9.1	10	12.7
Severe erosion risk					
Centerline only	Miles	6.7	3.7	5.2	3.7
New roads + closed roads with high upgrade requirements	Acres	8.9	4.2	4.2	3.1
High sediment delivery					
Centerline only	Miles	5.1	1.1	1.1	0.4
New roads + closed roads with high upgrade requirements	Acres	6.3	1.5	1.5	0.5
Slope failure					
Centerline only	Miles	9.3	6.4	7.9	9.2
New roads + closed roads with high upgrade requirements	Acres	13.3	3.6	3.7	7.4
Slopes > 30 percent					
Centerline only	Miles	7.4	5.2	2.9	3.4
New roads + closed roads with high upgrade requirements	Acres	16.5	2.1	1.3	2.1

[†]Does not include new roads within the transmission line right-of-way.
Source: GIS analysis by ERO Resources Corp. using vegetation mapping in USDA Forest Service and Natural Resources Conservation Service 1995.

Alternative C – Modified North Miller Creek Alternative

The Modified North Miller Creek Alternative would be 13.4 miles long, require 80 structures, and end at the substation at the Libby Plant Site, which is about 1.5 miles east of the proposed substation at the Ramsey Plant Site under Alternative B. The centerline would cross 5.2 miles of steep slopes, 3.7 miles of soils with severe erosion risk, and 1.1 miles of soils with high sediment delivery. The disturbance associated with structure placement would increase erosion until vegetation ground cover around the structure locations reached predisturbance vegetation ground cover levels. MMC would use a helicopter to harvest timber, reducing the need for access roads (Figure 45). Conventional logging techniques would be used in other areas. Helicopter logging would result in less soil erosion than conventional logging used in Alternative B.

New access roads and closed roads with high upgrade requirements would be needed for transmission line installation and would create 9.1 acres of disturbance, the fewest of all alternatives and about 22 acres fewer than Alternative B. These roads would disturb 4.2 acres of

soils having severe erosion risk, 1.5 acres of soils with high sediment delivery potential to waterways, 3.6 acres of soil that have potential for slope failure, and 2.1 acres of slopes greater than 30 percent. Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, and along Miller Creek and Fisher River. Soils having high sediment delivery potential along access roads occur along Libby and Miller creeks and at the northeast end along the Fisher River. Most soils having potential for slope failure along access roads occur just east of Libby Creek, along Miller Creek, and east of Fisher River. Access roads on slopes exceeding 30 percent occur primarily between Libby and Miller creeks, north of Miller Creek, and along portions east of Fisher River (Figure 82). MMC would develop and implement a Road Management Plan addressing all roads used in the alternative. Successful implementation of the plan would help minimize erosion and sediment delivery from roads.

Sediment controls and BMPs would be implemented on new roads to minimize erosion, sediment delivery to waterways, and slope failure. As with Alternative B, new access roads on National Forest System lands would be placed into intermittent stored service after line construction was completed. Intermittent stored service roads would be closed to traffic and would be treated, which would include at a minimum removing drainage obstructions, replacing salvaged soil, seeding, and installing cross drains, so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. Intermittent stored service is described in section 2.9.3.2, *Access Road Construction and Use*.

After removal of the transmission line, decommissioning transmission line roads on National Forest Systems lands would be similar as under Alternative 2. The road prism would be obliterated, all watercourses would be restored, and the road prism would be revegetated. Road decommissioning is described in section 2.9.3.2, *Access Road Construction and Use*. Unlike Alternative B, for Alternative C, the surface soil that had been in place on access roads for the life of the transmission line would be salvaged, the road prism obliterated, and then the surface soil replaced. The surface soil that had been in place for the life of the transmission line would have higher nutrient levels, higher organic matter content, and greater microbial activity than the underlying soil, and it would be a seed source for the native plants that had established over the life of the transmission line. This would shorten the amount of time for vegetation to re-establish, which would minimize the amount of time bare soil was exposed to erosive forces.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. As with Alternative B, final closure status of new access roads on private lands would be based on the landowner’s discretion. With fewer acres of disturbance and the shorter amount of time soil was exposed, impacts probably would be lower than those on Alternative B. With sediment controls, BMPs and short duration of exposed soil, there would be no severe reclamation constraints, no significant adverse impacts to the soil resources are expected, and the soil losses along access roads would likely be minor until vegetation was re-established in 3 to 5 years for most areas. Vegetation re-establishment on steep areas, particularly on south- and west-facing slopes, would take longer.

Alternative D – Miller Creek Alternative

The Miller Creek Alternative would be 14.1 miles long, require 95 structures, and end at the substation at the Libby Plant Site. This alternative would cross the least amount of areas of steep slopes (2.9 miles). Erosion and sediment delivery associated with structure placement would be

slightly more than Alternative C, and less than Alternative B (Table 134). Some areas would be logged using a helicopter, resulting in disturbances and erosion similar to Alternative C.

New access roads and closed roads with high upgrade requirements would create 10 acres of disturbance (about 21 fewer acres than Alternative B), and disturb 4.2 acres of soils having severe erosion risks, 1.5 acres of soils with high sediment delivery potential to waterways, and 3.7 acres of soil that have potential for slope failure. Access roads for this alternative would cross the fewest acres of slopes that exceed 30 percent (1.3 acres). Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, along Miller Creek and Fisher River. The majority of soils with high sediment delivery potential along access roads occur along Libby and Miller creeks and at the northeast end along the Fisher River. Most soils having potential for slope failure along access roads occur southeast of Libby Creek near Howard Lake, along Miller Creek, and east of Fisher River (Figure 82). Other effects and measures to control soil losses associated with the transmission line and corresponding access roads would be the same as Alternative C.

Alternative E – West Fisher Creek Alternative

The West Fisher Creek Alternative would be 14.9 miles long, require 101 structures, and end at the substation at the Libby Plant Site. The centerline would cross 3.4 miles of steep areas, similar to Alternative D. Erosion associated with structure placement would likely be the lowest in Alternative E, which would cross 3.7 miles of soils with severe erosion risk, and 0.4 mile of soils with high sediment delivery. Some areas would be logged using a helicopter, resulting in disturbances and erosion similar to Alternative C.

New access roads and closed roads with high upgrade requirements would create 12.7 acres of disturbance (about 18 fewer acres than Alternative B), and would disturb 3.1 acres of soils having severe erosion risks, which occur primarily along Libby and West Fisher creeks and Fisher River. This alternative would affect few soils with high sediment delivery potential (0.5 acre), and would affect 7.4 acres of soils with a potential for slope failure, which occur southeast of Libby Creek near Howard Lake, north of West Fisher Creek, and east of Fisher River. Access roads would cross 2.1 acres having slopes greater than 30 percent, which occur primarily along portions north of West Fisher Creek and along portions east of Fisher River (Figure 82). Other effects and measures to control soil losses associated with the transmission line and corresponding access roads would the same as Alternative C.

3.18.4.3 Soil Physical, Biological, and Chemical Characteristics

Soil characteristics that would be impacted by action Alternatives 2, 3, and 4 include changes in soil physical properties, biological activity, and nutrient levels. The likelihood of changes in chemical properties such as changes in heavy metal concentrations and soil pH are also discussed.

3.18.4.3.1 Alternative 1 – No Mine

Under Alternative 1, the Montanore Project would not be developed. Soil changes in physical and chemical properties, biological activities, and nutrient levels would be limited to any existing exploration-related or baseline collection disturbances. All existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. In all other areas, soil changes in physical and chemical properties, biological activities, and nutrient levels would continue at natural rates.

3.18.4.3.2 Alternative 2 – MMC Proposed Mine

Alternative 2 - Physical Characteristics

Single lift soil salvage and replacement would alter the natural soil profile by mixing soil horizons that developed over the past 10,000 years. MMC would use the single lift salvage and replacement method at the Ramsey Plant Site, the Libby Adit Site, the LAD Areas, and access roads. The Little Cherry Creek Tailings Impoundment Site would have soils salvaged and replaced in two lifts. This would limit impacts from mixing soil horizons but the loss of soil development and the length of time to re-establish a new soil profile would still take a long time. Other disturbances where soils would be salvaged using a two-lift method, the soils would be replaced using a single-lift method. There would be a long-term impact to the soil profile at these sites. Over time, natural processes would rebuild a new soil profile that may or may not resemble the predisturbance condition. The loss of soil development and the time needed to redevelop a new soil profile would be an unavoidable impact of soil disturbance.

To minimize soil compaction, MMC would rip compacted areas before redistribution of soil. Areas expected to be ripped include the adit portal areas, roads, soil stockpile sites, the dam face of Little Cherry Creek Tailings Impoundment, and facility areas. Ripping also would eliminate potential slippage at layer contacts and promote root growth. Following soil redistribution, the seedbed would be disked and harrowed on slopes 33 percent or less, which would minimize compaction of the seedbed. These practices would tend to offset compaction on many reclaimed sites. Some areas, such as road fills and as much as possible at the tailings impoundment site, would receive direct-hauled soil. If seeded immediately, and provided that soils are handled when dry, compaction would be minimal. MMC has not committed to handle soils when dry. If soils were wet when handled, some compaction would be expected, especially on slopes greater than 33 percent because the seedbed on these slopes would not be disked and harrowed. The establishment of vegetation, root systems, rodent activity, and physical processes such as freezing and thawing, and wetting and drying would decrease soil compaction. In time, effects related to soil compaction of respread soils would be reduced.

Alternative 2 - Biological Activities

The loss of organic matter and mycorrhizae in soils stockpiled for prolonged periods could lower plant species diversity (Reeves *et al.* 1979 In USDA Forest Service and DEQ 2001). If mycorrhizae-inoculated trees and shrubs species were readily available, MMC would use these species and would use stock raised in containers where the soil medium has been inoculated with mycorrhizae, if it were available. The loss of organic matter and mycorrhizae would be a long-term impact, and if mycorrhizae inoculation were not completed, the long-term survival and growth of woody species, in particular, may be reduced. In time, mycorrhizae would invade reclaimed sites from adjacent undisturbed areas, and species diversity would eventually increase, but not to pre-mine levels as discussed in section 3.21.1.4, *Environmental Consequences* of section 3.21, *Vegetation*.

Alternative 2 - Soil Nutrients

As is typical of many forest soils, nutrient levels are low to very low partially due to low soil pH. During soil storage, these levels would only decrease as organic matter and biological activity decreased and precipitation leached nutrients through the stockpiles. Soil stockpiles would contain organic debris, such as residual coniferous forest slash that was acidic, that could decrease soil pH as the material weathers.

Soils formed in volcanic ash often fix phosphorus in a form unavailable for plant uptake (Jones *et al.* 1979 *In* USDA Forest Service and DEQ 2001). Organic matter in the upper few inches of native soils acts as a reservoir for phosphorus. Plant-available phosphorus is released by microbial decomposition within and directly below the forest litter layer. Replaced soils would lack organic matter, as explained above; therefore, surface applications of soluble phosphorus fertilizer at the time or prior to seeding, as proposed by MMC, may be of little value. MMC has proposed to apply organic matter in the form of straw mulch, which has little nutrient value, and wood mulch may be used if straw mulch proved to be ineffective for successful reclamation. MMC would test areas with poor plant germination and/or growth to determine causes of unsuccessful revegetation and then take corrective actions. This would help offset organic matter and/or phosphorous deficiencies.

MMC proposes to salvage equal volumes of first-lift soils and second-lift soils at borrow sites C and D. In doing so, MMC may not necessarily segregate the most suitable soil that would be used as the upper 9 inches of respread soil. Mixing surface soil with subsoil would reduce organic matter content in first-lift replaced soils, which would affect availability of essential nutrients. This may also affect the success of plant re-establishment unless additional organic matter was applied to these areas. The same would be true with using single-lift soil salvage and replacement method at the sites mentioned above. This would mix soil horizons and thereby reduce organic matter content in first-lift replaced soil at these sites.

To minimize these impacts, MMC would complete soil tests prior to seeding to determine the appropriate fertilizer rates required for successful reclamation. Fertilizer and mulch would be applied on respread soils at the time and prior to seeding, and nitrogen fertilizer would be broadcasted over the soil surface after seeding early in the subsequent growing season. MMC's proposed soil testing program to identify fertilizer and other possible soil amendment needs, and taking corrective actions in areas of poor plant growth would help offset nutrient deficiencies in respread soils in the short term, and then when vegetation became re-established and soil building processes began on reclaimed areas, nutrient levels would eventually reach predisturbance levels.

Alternative 2 - Chemical Characteristics

Seeps from soil stockpiles in forested regions in other parts of Montana have indicated elevated levels of iron and manganese (USDA Forest Service and DEQ 2001). The levels of tannic acids increase and soil pH is reduced due to the breakdown of coniferous forest vegetation in the stockpiles. Low pH and increased levels of iron and manganese can result in complex nutrient deficiency and/or phytotoxicity problems in many plant species (Knezek and Ellis 1980 *In* USDA Forest Service and DEQ 2001; Kabata-Pendias and Pendias 1984 *In* USDA Forest Service and DEQ 2001). Reduced plant growth and/or mortality would slow or severely impair reclamation. Applications of composted organic matter have helped improve plant growth on reclaimed sites with affected soils (Vodehnal 1993 *In* USDA Forest Service and DEQ 2001). MMC has proposed to apply straw mulch but would test areas with poor plant germination and/or growth to determine causes of unsuccessful revegetation and then take corrective actions.

3.18.4.3.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

To better preserve the natural soil profile, double-lift soil salvage and replacement would be used at most disturbances, including the Poorman Tailings Impoundment Site, Libby Plant Site, LAD Areas, and along access roads that already had been cleared areas to store additional soil or that are near other soil stockpile areas, Single-lift salvage and replacement would be used along road

segments that do not have existing cleared areas large enough to store two lifts of soil or that are not near other soil stockpile areas. Where single-lift salvage and replacement would be used for access roads, the soil profile on reclaimed access roads would be more severely impacted and require more time to rebuild than at areas reclaimed using double-lift soil replacement method. Over time, natural processes would rebuild a new soil profile that may or may not resemble the predisturbance condition. The loss of soil development and the time needed to redevelop a new soil profile would be an unavoidable impact of soil disturbance.

To minimize compaction, all salvaged soils would be handled at the low moisture content, and all disturbed areas that have been resoiled and are to be seeded would be scarified to a depth of 6 to 12 inches prior to seeding to minimize compaction and improve seed establishment. The entire tailings impoundment and severely compacted areas, such as roads, soil stockpile sites, and facility sites would be ripped up to 18 inches deep with dozer ripping teeth prior to soil replacement to reduce compaction and break up surface crust to facilitate water infiltration and enhance rooting depth. Soil compaction would be short-term in all disturbed areas with these mitigation measures, and following reclamation compaction in respread soils that are ripped would be similar to pre-mine soils.

Where redistributed soils cover non-native material, such as the entire Poorman Tailings Impoundment and if any waste rock storage areas remained at the end of mining, an average of 24 inches of soil would be replaced in two lifts to provide sufficient rooting depth. Other reclaimed sites in Montana have shown that 24 inches of respread soil provides sufficient rooting depth (Plantenberg, pers. comm. 2006).

To promote the rebuilding of mycorrhizae in areas where trees are to be planted in respread soils that have been stored for prolonged periods, either an agencies-approved wood-based mulch would be incorporated into the upper 4 inches of respread soil (Plantenberg, pers. comm. 2006), and/or inoculated tree-planting stock with the appropriate mycorrhizal fungi would be used, or mycorrhizal fungi would be incorporated into the soil as pellets during seeding.

As mentioned earlier, organic matter in the upper few inches of native soils acts as a reservoir for phosphorus, and replaced soils that were stored for prolonged periods would lack organic matter. To enhance phosphorus and other nutrient levels and to increase organic matter levels, the upper 4 inches of respread soil would be amended with an agencies-approved wood-based organic amendment before planting. This would stimulate the development of fungal based mycorrhizae in the new soil.

Because of the observed metal leaching and low pH problems from soil stockpiles containing large amounts of coniferous vegetation at other mine sites in Montana, most coniferous forest debris would be removed before soil salvage. This also would minimize soil nutrient losses, because low pH conditions can result in complex nutrient deficiency and/or phytotoxicity problems.

The additional mitigation measures of Alternative 3 for limiting the total loss of the natural soil profile, soil compaction, loss of soil biological activity, and reduction of nutrient levels would reduce the severity of these impacts when compared to Alternative 2. In addition, these measures would enhance reclamation success more than Alternative 2 would.

3.18.4.3.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Modifications for Alternative 4 would be similar to the modifications in Alternative 3. The effects of these modifications would be similar as well. The difference would be the tailings impoundment would be at the same location as for Alternative 2, and 24 inches of soil would be respread over the entire Little Cherry Creek Tailings Impoundment including the top of the impoundment.

As with Alternative 3, to better preserve the natural soil profile, double-lift soil salvage and replacement would be used at most disturbances, including the same disturbances as Alternative 3 but also at the Little Cherry Creek Tailings Impoundment Site and the Little Cherry Creek Diversion Channel. Single-lift salvage and replacement would be used for some roads segments as Alternative 3.

3.18.4.3.5 Transmission Line Alternatives

Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Soil changes in physical and chemical properties, biological activities, and nutrient levels would continue at natural rates. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

Alternative B – North Miller Creek Alternative

Changes in physical properties of the soils due to handling under the North Miller Creek Alternative would be similar to those listed in section 3.18.4.1, *Effects Common to All Action Alternatives*. The natural soil profile would be altered, there would be a loss of soil pore space (an increase in compaction), and a loss of organic matter due to mixing. Most of these changes in the soil (except alteration of the soil profile) would be short-term, in part because all access roads would have soil replaced (if soil were removed) and would be reseeded immediately following transmission line completion. Additionally, protective vegetation on road surfaces would establish more quickly because soils stockpiled for short durations are still biologically active and retain a higher level of favorable physical and chemical characteristics than soils stored for prolonged periods. To minimize soil compaction, MMC would rip access roads, if necessary, when no longer needed. Following soil replacement, the seedbed would be disked and harrowed, which would minimize compaction of the seedbed.

Soils would be salvaged in a single lift for new access roads and for some existing roads altering the natural soil profile that developed over thousands of years. The establishment of vegetation, root systems, and physical processes, such as freezing and thawing, and wetting and drying, would help rebuild a new soil profile, but this would be a long-term impact and would require a long time.

Alternative C – Modified North Miller Creek Alternative

Changes in physical, chemical and biological properties of the soils due to handling from road construction and interim reclamation under the Modified North Miller Creek Alternative would be similar to those listed under the North Miller Creek Alternative.

Because with final reclamation, the surface soil that had been in place for the life of the transmission line would be salvaged and then replaced after the road prism was obliterated, changes in physical and biological properties of the soils due to handling under the Modified North Miller Creek Alternative would be less than under the North Miller Creek Alternative. The natural soil profile would still be altered but not as severely, there would still be a loss of soil pore space (an increase in compaction), the loss of organic matter would be reduced due to less mixing of the soil, and the soil biological activity would be less affected. This would shorten the time to re-establish vegetation and for successful reclamation. The better soil handling methods and the fewer acres of disturbance under the Modified North Miller Creek Alternative (Table 134) would reduce the effects of impacts when compared to the effects in the North Miller Creek Alternative.

Alternative D – Miller Creek Alternative

Changes in physical, chemical, and biological properties of the soils due to handling in the Miller Creek Alternative would be similar to Alternative C.

Alternative E – West Fisher Creek Alternative

Changes in physical, chemical, and biological properties of the soils due to handling in the West Fisher Creek Alternative would be similar to Alternative C.

3.18.4.4 Reclamation Success

Factors important to successful reclamation include soil salvage and handling, vegetation removal and disposition, revegetation, and success criteria.

3.18.4.4.1 Alternative 1 – No Mine

Under Alternative 1, the Montanore Project would not be developed. Reclamation would be limited to any existing exploration-related or baseline collection disturbances. All existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits.

3.18.4.4.2 Alternative 2 – MMI Proposed Mine

MMC's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Specific goals of reclamation serve a number of purposes as described in MMC's reclamation plan (MMC 2007).

Alternative 2 - Soil Salvage and Handling

Table 133 presents a comparison of the likely disturbances in which soil would be salvaged and salvageable soil volumes of mine facilities for each alternative. The table shows salvageable volumes for first lift and second lift soil. Even though MMC proposes to use double-lift salvage at the Little Cherry Creek Diversion Channel and other potential disturbances within the Little Cherry Creek Tailings Impoundment, they do not propose to use a double-lift replacement at these sites. These second-lift soils would only be used on the tailings impoundment.

MMC proposes to redistribute 24 inches of soil on the embankment of the Little Cherry Creek Tailings Impoundment using a double-lift salvage and replacement method. Replaced soil depths on other disturbed areas would be 18 inches including the top of the tailings impoundment. The double-lift salvage and replacement would provide enhanced soil physical and chemical properties in the reclaimed surface soil layer. First-lift soils would have more favorable conditions for revegetation establishment, such as higher organic matter content, higher nutrient levels, and

better soil structure, which has higher porosity that facilitates plant root development. This practice attempts to salvage and replace some of the natural soil profile characteristics that developed on the site since the last major climatic change.

Total soil disturbance of the Little Cherry Creek Tailings Impoundment would be 620 acres (Table 133). Soils in the impoundment area, in part, would be replaced based on soil erodibility and slope steepness. For example, the least erodible colluvial/glacial soils having the greatest rock fragment content would be used as subsoil (15 inches thick) on the embankment of the impoundment to minimize erosion potential. Rock fragments reduce the erodibility of soils by anchoring the surface. First-lift soils, would consist of both rocky and non-rocky surface soils, and would be used as surface soil over the entire impoundment including the embankment. Soil replacement on the embankment would be in two lifts; 15 inches of rocky subsoil on bottom followed by 9 inches of surface soil on top. Over the rest of the impoundment MMC proposes soil replacement in two lifts; 9 inches of second-lift soil followed by 9 inches of first-lift soil. If MMC did not use rocky soil for the upper 9 inches on the tailings embankment, erosion of the surface may occur and exposed the less fertile subsoil. If this happened, successful reclamation on the tailings embankment may not be achieved.

The tailings material would be composed of sands and silts that would not be phytotoxic (lethal or damaging to plants). It is likely that this material, especially the silts, would become hard and compacted upon drying. Without scarification or deep ripping before soil placement, this fine tailings material could become an effective barrier to root penetration and could affect long-term establishment of deep rooted plants such as trees and shrubs. Because tailings on the dam face would be coarser and because MMC proposes to deep rip the dam face before soil placement, a physical rooting barrier on the dam face would not be an issue.

Material below salvageable soil depths from borrow areas that occur outside the footprint of the Little Cherry Creek Tailings Impoundment would be used for construction on portions of the Saddle Dams, Starter Dam, Seepage Collection Dam, or toe dike. These borrow areas would create about 419 acres of disturbance (Table 133), and have an average of 14 inches of salvageable soils. About 277 acres of soil in this area have not been mapped at a site-specific intensive level. In addition, about 43 acres of soil in other disturbances in the impoundment area and 139 acres of road disturbance requiring soil salvage and replacement have not been mapped at an intensive level. Not mapping the soils at an intensive level before salvage may result in not salvaging all suitable soil and/or salvaging some unsuitable soils, such as soils having low pH conditions. If unsuitable soils were used as respread soils, plant establishment may be adversely affected.

The total disturbance for the Ramsey Plant Site would be 52 acres. Salvageable soil depths at the site are about 24 inches, of which MMC proposes to salvage 18 inches in one lift. The total disturbances for the Little Cherry Creek Diversion Channel would be 40 acres. Salvageable soil depths along the Diversion Channel are about 13 inches, of which MMC proposes to salvage about 9 inches in one lift. The total disturbance from roads would be about 149 acres, on which MMC proposes to salvage and replace soils in one lift. Not utilizing the double-lift salvage and replacement method would mix the relatively organic-rich and nutrient-rich surface soil layer with the poorer quality subsoil layer and place more unproductive soil on the surface. Again, plant establishment may be reduced and could take longer for reclamation success to be achieved.

The total soil disturbance for the LAD Areas 1 and 2 would be 31 acres. The disturbed areas at the LAD Areas would include ponds, embankments, ditches, soil stockpile areas, and access roads. LAD Area 1 also would include a waste rock disposal area. LAD Area disturbances would require soil salvage (except soil stockpile areas) and reclamation. The larger areas used for land application and disposal would require only selective thinning of trees, access road construction, and little soil removal. Salvageable soil depths at LAD Areas average about 9 inches, but MMC would respread 18 inches of soil over the disturbances at LAD Areas. Some soil likely would be hauled from elsewhere to compensate for the shortage of salvaged soil at LAD Areas. Impacts to reclaimed disturbances at the LAD Areas would be the same as other areas not having a double-lift soil replacement.

Many of the impacts resulting from soil salvage and handling would be moderate in the long term for comparable stability and utility determinations. Long-term effects could occur on the embankment of the Little Cherry Creek Tailings Impoundment if surface erosion occurred and exposed subsoil. Long-term effects could occur on the top of the impoundment if the surface were not ripped to break up any rooting barriers, at areas where unsuitable soils may be used, and at areas where the double-lift soil replacement were not used.

Alternative 2 - Vegetation Removal and Disposition

MMC has not proposed any special plan to deal with vegetation removal and disposition other than harvesting trees and burning slash. This may result in the loss of a source of native plant materials, less organic debris that could be used for BMPs, and loss of potential non-coniferous organic enrichment in stockpiled soils. Opportunities to enhance reclamation success could be lost. If too much coniferous forest debris were left on the soil and salvaged with the soil, soil pH in the stockpiles could be reduced.

Alternative 2 - Revegetation and Success Criteria

MMC has developed two final seeding/planting mixes to accommodate the differences in disturbance areas and an interim seed mix (MMC 2007). These mixes would be dominated by native species; some introduced species would be included. Introduced species may hinder colonization of native species and could spread off the reclaimed areas. Prior to reclamation, MMC would submit seed mix information to the lead agencies, so that the agencies would have an opportunity to adjust seed mixes as appropriate for site conditions and to meet any KFP changes. If the agencies required removal of introduced species from seed mixes, the adverse long-term effects that introduced plant species would have on reclaimed sites and surrounding areas would be reduced.

Trees and shrubs would be planted on steeper slopes of the Little Cherry Creek Tailings Impoundment throughout the project life as areas were reclaimed, on cut-and-fill slopes at the Ramsey Plant Site, the Libby Adit Site, and portions of LAD Areas. MMC would plant trees and shrubs at the end of operations on all other disturbances including the top of the impoundment and waste rock dumps, if present at the end of operations. Trees and shrubs would not be planted on the Rock Lake Ventilation Adit, soil stockpile sites, portal patios, and along road corridors. In these areas, reforestation would occur by natural regeneration. This approach would increase the time needed to achieve a natural looking setting, to provide screening, and to achieve important wildlife habitat components. A well-established grass cover in these areas likely would retard the establishment of volunteer trees. It may take up to 20 years for settling to stop and to complete

redistributing soil on top of the tailings impoundment. Delaying tree and shrub planting on top of the tailings impoundment would delay development of wildlife habitat.

MMC's proposed 18 inches of respread soil on top of the tailings impoundment, rather than 24 inches, and not ripping the tailings surface to break up surface crusting before soil placement may hinder tree root growth and overall growth rates likely would decline. Root systems would eventually penetrate the tailings, but the mass of roots likely would be concentrated in the upper 18 inches of soil, resulting in slower growing and possible stunted trees over time, and trees would likely be more prone to wind throw.

MMC proposes to plant 435 trees per acre; based on a survival rate of 65 percent, the final anticipated stocking rate after 15 years would be about 283 trees per acre. Shrubs would be planted at a rate of 200 stems per acre. The proposed planting rates may not meet overall wildlife or density recommendations by the agencies, and would require many years before stem densities on reclaimed sites have similar densities to that of surrounding landscapes.

The proposed planting plan includes the spacing of trees and shrubs to be continuous on slopes in strips alternating with strips that would be seeded with an herbaceous understory mixture, or would be spaced in randomly placed groupings on level to gently sloping areas. Planting in alternating strips would not match surrounding landscape features, would not meet visual quality objectives and may allow for noxious weed establishment along the planting strips.

If feasible, MMC would consider collecting seed or plant materials onsite to ensure the genetic adaptation of planting stock to local environmental conditions, and inoculating soils used for planting trees and shrubs with mycorrhizae. This would enhance the chances for survival, growth, and reproduction, which are necessary for long-term successful reclamation.

In summary, MMC's revegetation plan may affect long-term reclamation success and results. Potential effects include the introduction of non-native plant species, extended establishment time for trees and shrubs in some areas, and reduced woody plant densities. The potential for the spread of noxious weeds may also increase.

Part of MMC's reclamation goals include revegetation success criteria, which are anticipated to be met after a 3 to 5 year monitoring period. These success criteria include:

- Total plant cover would be at least 80 percent of the total cover of a specific control site or would meet a 70 percent total cover basis with at least 60 percent consisting of a live plant community
- There would be no more than three acceptable plant species that dominate a site based on the seed mix or natural plant community in the area, and noxious weeds would not be more than 10 percent of the plant community
- There would be no rills and gullies greater than 6 inches deep and/or wide

If any success criterion were not met after 3 years of monitoring, MMC would access the problems and correct any deficiencies of seed types, techniques or methods and take corrective measures. This process would continue until all revegetation goals were met.

3.18.4.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Short- and long-term reclamation objectives would remain the same as for Alternative 2. Modifications and their effects to soil salvage and handling, vegetation removal and disposition, revegetation, and success criteria are discussed below.

Alternative 3 - Soil Salvage and Handling

Soil would be salvaged and replaced in all disturbed areas, with the exception of soil stockpile areas, slopes greater than 50 percent, and cut slopes in consolidated material. Where redistributed soils cover non-native material such as the entire Poorman Tailings Impoundment and waste rock piles (if remaining at end of mine life), the replaced soil depth would average 24 inches using two lifts. This would produce soil depths more comparable to pre-mine conditions and would increase the likelihood of successful revegetation. Research generally has shown that replacement of 24 inches of soil over suitable mine waste rock would produce maximum revegetation (Coppinger *et al.* 1993 *In* USDA Forest Service and DEQ 2001). At all other disturbances, soil replacement depths would average 18 inches. Double lift salvage and replacement also would occur at all disturbances requiring soil salvage and replacement except for some road segments and at the Upper Libby Adit, which would have 1 acre of disturbance and there would be no suitable second-lift soil. Double-lift soil salvage and replacement would be used along access roads that already have cleared areas to store additional soil or that are near other soil stockpile areas, To minimize disturbance size and tree removal, single-lift salvage and replacement would be used along road segments that do not have existing cleared areas large enough to store two lifts of soil or that are not near other soil stockpile areas. The lead agencies would identify road areas where double-lift soil salvage and replacement would be appropriate. Reclamation would be enhanced by salvaging some soils to greater depths to provide sufficient salvageable soil volumes to achieve the soil replacement goals for all potential disturbances.

About 49 acres of soil at Borrow Area 2 and the potential rock borrow area, all soils at the Libby Plant Site (104 acres), about 183 acres of soil at other potential disturbances within the Poorman Tailings Impoundment Site, and about 125 acres of soil along roads have not been mapped at an intensive, site-specific level. Before any soils would be salvaged, intensive soil surveys would be conducted in these areas to ensure the most suitable soil and necessary volumes of soil were salvaged.

Other modifications of soil salvage and handling have been discussed in section 2.5.3.2, *Vegetation Clearing and Soil* Salvage *and Handling Plan*. These other modifications along with thicker soil replacement depths at most disturbances, and the most suitable soil and maximum volumes would be salvaged, would help to assure both short-term and long-term successful revegetation.

Alternative 3 - Vegetation Removal and Disposition

As described in section 2.5.3.2.1, *Vegetation Removal and Disposition*, a Vegetation Removal and Disposition Plan that would evaluate the potential uses of vegetation removed from areas to be disturbed and would describe disposition and storage plans during mine life would be prepared. This plan would result in the maximum use of native plant materials and organic debris for BMPs to enhance reclamation success. Where possible, slash of non-coniferous forest debris from timber-clearing would be salvaged and chipped to be used as mulch or as an additive to stored surface soil stockpiles. Because of the observed metal leaching from soil stockpiles containing

large amounts of coniferous vegetation at other mine sites in Montana, coniferous forest debris would be removed before soil removal.

Alternative 3 - Revegetation and Success Criteria

Revegetation and success criteria would be developed for all reclaimed areas. These criteria would help assure revegetation was successful over both the short and long term, that noxious weeds did not exceed unacceptable levels, and desired cover densities were achieved and sustained in the long term.

Alternative 3 includes more stringent requirements for mine reclamation than Alternative 2 (Table 135). A 20-year revegetation monitoring period after reseeding would be required under Alternative 3 to better assure that revegetation requirements have been achieved. A longer monitoring period also would provide additional time to take corrective measures if revegetation goals had not been met.

The reclamation requirements for Alternative 3 would increase the minimum vegetation cover required after reclamation compared to Alternative 2. A total of 80 percent of total cover would be the goal compared to 70 percent for Alternative 2. Alternative 3 would require a sufficient planting of trees and shrubs to achieve 400 trees and 200 shrubs per acre living after 15 years, except in wetlands and meadows. Compared to Alternative 2, this would increase woody plant density. Woody plant densities under Alternative 3 would better match surrounding landscape features and would meet wildlife and density recommendations provided by the agencies.

All seed mixes would be revised so that mixes would be composed of species native to northwestern Montana (if commercially available) instead of a seed mix that that includes introduced species as proposed in Alternative 2. This would reduce the spread of aggressive introduced species both in reclaimed sites and nearby sites, and enhance the conditions for re-establishment of native species.

Rather than planting trees and shrubs along strips as proposed in Alternative 2, trees and shrubs would be planted by hand in random patterns to better resemble natural surroundings. Planting in random patterns along with increased woody plant densities, would return reclaimed sites to more natural conditions in less time than under Alternative 2.

Surface soil would be amended before seeding with an agencies-approved wood-based organic amendment to raise soil organic matter levels to a minimum of 1 percent by volume. This would increase water holding capacity of the soil, enhance nutrient levels, stimulate biological activity in the soil, and thereby, help ensure successful revegetation.

3.18.4.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Short- and long-term reclamation objectives would remain the same as for Alternative 2. Modifications to soil salvage and handling, vegetation removal and disposition, revegetation, success criteria, and monitoring are the same as described above in Alternative 3, with a few modifications described below.

Table 135. Mine Reclamation Requirements by Alternative.

Reclamation Requirement	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Tailings Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Tailings Impoundment Alternative
Seed Mix	Native and introduced species; interim and permanent seed mixes	Native; permanent seed mix only	Native; permanent seed mix only
Tree/Shrub Density After 15 Years	283 trees/acre (assumes a 65% survival rate of 435 trees/acre planted) Unspecified (200 shrubs/acre planted)	400 trees /acre 200 shrubs/acre	Same as Alternative 3
Noxious Weeds	No more than 10% noxious weeds	Less than 10% cover of Category 1 weeds and 0% of Category 2 and 3 weeds†; Category 1 weeds would not dominate an area greater than 400 sq ft	Less than 10% cover of Category 1 weeds and 0% of Category 2 and 3 weeds†; Category 1 weeds would not dominate an area greater than 400 sq ft
Total Cover Goal	60% live vegetation cover or 70% of control site total cover	80% of control site total cover	80% of control site total cover
Monitoring Plan	3 consecutive years of revegetation success	20 years	20 years
Total Acres of Vegetation Disturbance	2,582	2,011	2,254

†Priority weeds described in KFP; see Table 148 in section 3.21, *Vegetation*.

Alternative 4 - Soil Salvage and Handling

In Alternative 4, as under Alternative 3, where redistributed soils cover non-native material such as the entire Little Cherry Creek Tailings Impoundment Site and waste rock piles (if remaining at end of mine life), the replaced soil depth would average 24 inches using two lifts. Sufficient salvageable soil volumes are available to achieve the soil replacement goals for all potential disturbances.

The soils at the Libby Plant Site (same as Alternative 3), about 35 acres of soils in the southwestern portion of the Borrow Area outside the impoundment footprint, and about 125 acres of soil along access roads have not been mapped at an intensive, site-specific level. Before any

soils would be salvaged, MMC would conduct intensive soil surveys in these areas to ensure that the most suitable soil and necessary volumes of soil were salvaged. In addition, a two-lift soil salvage and replacement method would be conducted at the Libby Plant Site, at LAD Areas, along some portions of access roads, at other disturbances within the Little Cherry Creek Impoundment Site, and at the Little Cherry Creek Diversion Channel.

Other modifications of soil salvage and handling incorporated into Alternatives 3 and 4 have been discussed in section 2.5.3.2, *Vegetation Clearing and Soil* Salvage *and Handling Plan*. These modifications along with the modifications mentioned above would help ensure successful long-term revegetation.

3.18.4.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.18.4.4.6 Alternative B – MMC Proposed North Miller Creek Alternative

Alternative B - Soil Salvage and Handling

Soils would be salvaged and replaced using a single-lift method and would be handled in the same manner as explained in Alternative 2. Not using the double-lift salvage and replacement method would mix relatively organic-rich and nutrient-rich surface soil with poorer quality subsoil and place more unproductive soil on the surface, which could delay successful reclamation. Where soils are salvaged from new access roads, the soil would be stored adjacent to the disturbance.

Roads opened or constructed for transmission line access would be closed after the transmission line had been built. The road surfaces would be reseeded as an interim reclamation activity designed to stabilize the surface. Where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded. The new road prism would remain until the transmission line was removed at the end of operations. After the transmission line was removed, all newly constructed roads would be recontoured to match the existing topography, obliterating the road prism.

Alternative B - Vegetation Removal and Disposition

MMC has not proposed any special plan to deal with vegetation removal and disposition other than harvesting trees and burning slash. This could result in the loss of a source of native plant materials, less organic debris for BMPs such as slash filter windrows or use of chipped non-coniferous wood debris, and loss of potential organic enrichment in stockpiled soils. Opportunities to enhance reclamation success could be lost.

Alternative B - Revegetation and Success Criteria

At the end of the mine life and following redistribution of soil, all access roads would be reseeded with the same seed mixes as in Alternative 2. MMC has not proposed to plant trees on reclaimed access roads and other disturbances where trees were removed such as line stringing and

tensioning sites, slash burn piles, and construction pads. MMC's revegetation plan for the transmission line access roads would have the same long-term effects as under Alternative 2, including the spread of introduced plant species, the additional years required for trees and shrubs to become established on reclaimed road surfaces and other disturbance sites, and the potential for spreading noxious weeds. The revegetation, success criteria, and monitoring would be the same as under Alternative 2.

3.18.4.4.7 Alternative C – Modified North Miller Creek Alternative

Alternative C - Soil Salvage and Handling

Under the Modified North Miller Creek Alternative, soil salvage and handling would be the same as under Alternative B for road construction and for interim reclamation. The effects to soils also would be the same.

For final decommissioning of access roads, the surface soil that had been in place on access roads for the life of the transmission line would be salvaged, the road prism obliterated, and then the surface soil replaced. The surface soil that had been in place for the life of the transmission line would have higher nutrient levels, higher organic matter content, and greater microbial activity than the underlying soil, and it would be a seed source for the native plants that had established over the life of the transmission line. This would shorten the amount of time for vegetation to re-establish. The depth of surface soil salvage would be determined by the lead agencies prior to final reclamation. Other soil handling methods would be in the same manner as under Alternative B.

At the end of operations, mycorrhizae and an agencies-approved wood-based mulch would be incorporated into the upper 4 inches of soil to raise the soil organic matter levels to 1 percent by volume in the recontoured road surfaces. This would shorten the amount of time to successfully reclaim all transmission line access roads.

In Alternatives C, D, and E, wooden structures would be used (steel monopoles would be used a 1-mile segment of Alternative E). Wooden poles would be treated to reduce decay; a typical preservative contains sodium, copper and petroleum compounds. Typically, soil contamination surrounding a pole is non-existent or very minor.

Alternative C - Vegetation Removal and Disposition

As described in section 2.5.3.2.1, *Vegetation Removal and Disposition*, a Vegetation Removal and Disposition Plan would be prepared that evaluates the potential uses of vegetation removed from areas to be disturbed. This plan would result in the maximum use of native plant materials and organic debris for BMPs to enhance reclamation success.

Alternative C - Revegetation and Success Criteria

Trees would be planted in all areas where trees were removed for the construction of the transmission line including access roads and other disturbances such as line stringing and tensioning sites, slash burn piles, and construction pads. Trees would be planted at a density that at the end of 5 years the approximate stand density of the adjacent forest would be attained at maturity. This standard would not apply to roads placed in intermittent stored status, but would apply when the roads would be decommissioned after the transmission line was restored. Planting trees in disturbances would require less time for trees to become establish, would better match

surrounding landscape features, and would meet wildlife and density recommendations provided by the agencies.

All seed mixes for both interim reclamation and final reclamation would be revised so that mixes would be composed of species native to northwestern Montana and not contain introduced species. This would reduce the spread of aggressive introduced species both in reclaimed sites and nearby sites, and enhance the conditions for re-establishment of native species. The monitoring plan, revegetation, and success criteria (except tree and shrub densities) would be the same as under Alternative 3.

3.18.4.4.8 Alternative D – Miller Creek Alternative

For the Miller Creek Alternative, effects and modifications to soil salvage and handling, vegetation removal and disposition, revegetation, and success criteria would be the same as for Alternative C.

3.18.4.4.9 Alternative E – West Fisher Creek Alternative

For the West Fisher Creek Alternative effects and modifications to soil salvage and handling, vegetation removal and disposition, revegetation, and success criteria would be the same as for Alternative C.

3.18.4.5 Cumulative Effects

Past actions, particularly road construction, timber harvest, and mining activities have increased erosion rates in comparison to undisturbed areas in the analysis area. As vegetation in timber harvest areas return to pre-harvest conditions, erosion rates have and would continue to decrease. Cumulative effects to soils from other current and foreseeable actions would be associated primarily with potential soil loss from erosion and loss of soil productivity. Other regional current and foreseeable actions that would affect soil resources include timber harvest, mineral exploration, and new road construction. These actions would potentially occur on both public and private lands. There may also be abandoned mine waste cleanup on public and private lands, and continued commercial and residential development on private lands. The primary soil disturbance of many of these activities would be from road construction, and also from soil removal due to mine reclamation, home construction, paving of access roads and driveways, etc. These actions would result in an increase in erosion and sedimentation within the Libby Creek and Fisher River watersheds, and a loss of soil productivity in areas where soil was removed, stored for prolonged periods, and then replaced.

KNF requires the implementation of BMPs for logging, mine reclamation, and road-building operations. Private landowners are not required to use BMPs. If BMPs were properly implemented and maintained, onsite erosion and potential increases in sedimentation to creeks would be minimized, and soil erosion losses would be a minor cumulative impact. The loss of soil productivity associated with most of the current and foreseeable actions would be a minor impact. Permanent effects would occur where lands become unproductive due to paved or graveled road surfaces.

3.18.4.6 Regulatory/Forest Plan Consistency

Proposed lands allocated for the action alternatives would be reallocated to non-timber production land, consequently, the only standards in the KFP that would apply to these lands would be the implementation of BMPs to control erosion and sedimentation. Therefore, all action alternatives

would be in compliance with soil standards and guidelines outlined in the KFP, and all alternatives are expected to meet the forest plan standard for the protection of soils with their required mitigations implemented.

3.18.4.7 Irreversible and Irretrievable Commitments

Some soil would be irreversibly lost under all action alternatives during soil removal, construction, and operation of the mine prior to the re-establishment of vegetation. Some soil would be irreversibly lost under transmission line Alternatives B through E, especially during construction and final reclamation of access roads. Soil productivity would be irreversibly lost in large areas under Alternative 2, along portions of access roads under Alternatives 3 and 4, and along transmission line access roads under all alternatives where single-lift salvage and replacement was used, because the soil profile would be altered and would require many years for soil productivity to return to pre-mine conditions. The time required to restore soil productivity would be shortened with the use of soil amendments. A minor amount of soil productivity would be irreversibly lost under all action alternatives along NFS road #278 due to widening of the road.

Irretrievable effects to soil productivity would result from prolonged soil stockpiling and at disturbances that would not be reclaimed until the end of mine life, such as at plant sites and most of Little Cherry Creek and Poorman Tailings Impoundment sites. Irretrievable effects to soil productivity would result along transmission line access roads where road prisms would remain until final reclamation of the transmission line. These irretrievable effects would be minimized with the use of fertilizers and mulches. Irretrievable effects to soil productivity would be limited at areas under Alternatives 3 and 4 where double-lift soil salvage and replacement was used. The replaced lift soils under Alternatives 3 and 4 also would have wood-based mulch and mycorrhizae incorporated into the upper 4 inches of soil. These measures would accelerate the rebuilding processes for respread soils to reach pre-mine productivity levels. Irretrievable effects to soil productivity would be limited on access roads of transmission line under Alternatives C through E with removal and replacement of the surface soil for final reclamation, and with the addition of wood-based mulch and mycorrhizae into the upper 4 inches of soil during final reclamation.

3.18.4.8 Short-term Uses and Long-term Productivity

Soil losses due to erosion would be long-term, but would return to natural rates once vegetation was re-established and stabilized reclaimed areas, in about 3 to 5 years following reclamation. Over steepened and south- and west-facing cut slopes may require more than 5 years for the vegetation ground cover to reach predisturbance levels without soil amendments. Decreases in soil productivity would be long-term in all reclaimed areas. The degree of soil productivity losses would vary among the action alternatives and would be more severe under Alternative 2 and under transmission line Alternatives B through E in areas where single-lift soil salvage and replacement would be used. These areas primarily include the Ramsey Plant Site, the Little Cherry Creek Diversion Ditch, mine roads, the Libby Adit Site, and all transmission line access roads. Due to mixing of soil horizons and prolonged storage, soil profile characteristics would be drastically changed over pre-mine conditions. Soil productivity would decrease under Alternative 2 on the top of the Little Cherry Creek Tailings Impoundment if 18 inches of soil were placed over crusted fine-grained tailings, which would restrict rooting depth.

3.18.4.9 Unavoidable Adverse Environmental Effects

Loss of soil development since the last major climate change in the area would result in all action alternatives. Soil erosion to some degree would occur under all action alternatives, even with implementation of proposed mitigation measures. The degree of effects of soil erosion would be more severe under Alternative 2 and less under Alternatives 3 and 4 because of the additional erosion control methods and the fewer acres of soil disturbance under Alternatives 3 and 4. Loss of soil productivity would be unavoidable under all action alternatives in all disturbances where soil was removed, stored, and replaced. The degree of effects to soil productivity would be more severe under Alternative 2 and under transmission line Alternatives B through E where single-lift soil salvage and replacement was used.

3.19 Sound, Electrical and Magnetic Fields, Radio and TV Effects

3.19.1 Regulatory Framework

3.19.1.1 Sound

Noise is generally defined as unwanted sound, and can be intermittent or continuous, stationary or transient. Noise levels heard by humans and animals depend on several variables, including distance and ground cover between the source and receiver and atmospheric conditions. Noise can influence humans or wildlife by interfering with normal activities or diminishing the quality of the environment. Noise levels are quantified using units of decibels (dB). 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.

No federal, KNF, or county regulations govern noise levels in the analysis area (Big Sky Acoustics 2006). The EPA identifies outdoor noise levels less than or equal to 55 dBA are sufficient to protect public health and welfare in residential areas and other places where quiet is a basis for use. The Montana Department of Transportation (MDT) determines that traffic noise impacts occur if predicted 1-hour traffic noise levels are 66 dBA or greater at a residential property during the peak traffic hour (Big Sky Acoustics 2006). Noise associated with the transmission line is required to be 50 dBA or less at the edge of the right-of-way in residential and subdivided areas unless the affected landowner waives this condition (ARM 17.20.1607.2 (a)).

3.19.1.2 Electrical and Magnetic Fields

“EMF” is an abbreviation for the electric field and magnetic field associated with electric power systems. In the United States, these systems and their associated transmission lines operate at a frequency of 60 hertz (Hz), and therefore create 60-Hz EMFs. EMFs occur in the environment naturally and as a result of human activity. Naturally occurring EMFs are created by the weather and the geomagnetic field. The electric power transmission and distribution system is the principal source of environmental 60-Hz EMFs. EMFs are weak except near power lines, substations, electrical machinery, and appliances.

Electric fields from power lines are created when a voltage is placed on the conductors, a step known as energizing the line. Electric fields exist in the space surrounding an energized object and have a strength measured by the unit “volt per meter” (V/m) or 1,000 volts per meter (kV/m). Electric field strength is determined by the voltage on the line and does not change with power flow. Electric field strength attenuates rapidly with increasing distance from the power line and can be reduced by trees with foliage and houses and greatly reduced by metal and other conducting surfaces.

Magnetic fields from power lines are created whenever current flows through power lines. The strength of the field is directly dependent on the current in amperes in the line but not the voltage. Magnetic field strength near electric power lines is typically measured in milligauss (mG). Similar to electric field strength, magnetic field strength attenuates rapidly with distance from the source, but unlike electric fields, magnetic fields are not easily shielded by ordinary objects and

materials. Both electrical and magnetic fields are low energy, extremely low frequency fields, and should not be confused with high energy or ionizing radiation such as X-rays and gamma rays.

No federal, KNF or county regulations govern electrical and magnetic fields in the analysis area. Montana major facility siting regulations require that the electric field strength at the edge of the right-of-way be no greater than 1 kV/m in residential and subdivided areas unless the affected landowner waives this condition and that the electric field at road crossings be no greater than 7 kV/m (ARM 17.20.1607.2(d)). Montana has no regulation concerning 60-Hz magnetic fields of power lines.

3.19.1.3 Radio and TV Effects

Radio and television interference are collectively referred to as radio noise. Radio noise is a phenomenon produced by both corona and sparking and can vary greatly based on weather conditions. Television interference is significant only for foul weather conditions. Corona occurs when the electrical field at a particular point reaches a sufficiently high value to cause ionization of the surrounding air. Corona on transmission lines can cause power loss, radio, and television interference and audible noise near the transmission line.

No KNF, state or county regulations govern radio or television interference in the analysis area. The Federal Communications Commission (FCC) regulations pertaining to the prevention of radio and television interference vary by service. Such regulations are usually included in the operating requirements section for each service.

For transmission lines with normal conductor spacings and rights-of-way, a fair-weather radio interference level of about 40 decibel-microvolts per meter (dBμV/m) at a lateral distance of 100 feet from the outermost phase has been established as a guideline for identifying design criteria for a radio noise limit (IEEE Standard 430-1991).

3.19.2 Analysis Area and Methods

The analysis area encompasses an area potentially affected by project facilities: along the Bear Creek Road south from U.S. 2; the area surrounding the proposed mine facilities; and the area crossed by the four transmission line alternatives and associated access roads.

3.19.2.1 Sound

Woodward-Clyde Consultants collected ambient noise levels measurements at the Ramsey Plant Site and the Little Cherry Creek Tailings Impoundment Site in 1988 (Woodward-Clyde Consultants 1989c). Ambient noise levels in the analysis area are unlikely to have changed significantly since 1988. Big Sky Acoustics completed two, 5-minute noise level measurements in 2005 above the Troy Mine mill and portal (Big Sky Acoustics 2006). The Troy Mine is located about 20 miles northeast of the proposed Montanore Project and uses similar underground mining and milling techniques. Big Sky Acoustics developed predicted noise level contours that would develop under various operating conditions using noise prediction software.

3.19.2.2 Electrical and Magnetic Fields and Radio and TV Effects

Power Engineers calculated electrical and magnetic fields and radio and television interference for MMC's proposed structure configuration (Power Engineers 2005a). A steel monopole structure 90 feet in height was used in the analysis. BPA's corona and field effects program was

used in the calculations. A similar calculation using BPA's corona and field effects program was made for the H-frame structures that would be used in the other three transmission line alternatives (HDR Engineering 2007). The lead agencies completed an evaluation of the potential for environmental impacts from transmission line EMFs (Asher Sheppard Consulting 2007). The evaluation addresses the current status of scientific knowledge concerning potential health effects from exposure to transmission line EMFs.

3.19.3 Affected Environment

3.19.3.1 Sound

Except for the Libby Adit Site, existing sound levels in the analysis area are low, characteristic of rural areas and wilderness (Table 136). Nighttime sound levels are 4 to 12 dB lower than daytime levels due to cessation of many human-related activities. Wind conditions during the monitoring period were low, less than 15 mph, eliminating wind as a significant sound source. Natural sound sources include wind, wildlife, water flow, thunder, and wind-induced noise such as the rustling of foliage. Other sound sources include vehicles, such as trucks or airplanes, and man. The overall contribution from human activities is small, and the predominant sound sources are natural. Wildernesses typically have very low noise levels. The Rock Creek Final EIS reported daytime noise levels at the CMW boundary of 25 to 27 dBA (USDA Forest Service and DEQ 2001).

Large-lot residential properties, ranches, and cabins are found along U.S. 2 near Libby Creek Road (NFS road #231), Bear Creek Road (NFS road #278), the Fisher River, Pleasant Valley, and Schrieber Lake. Fifteen residences or cabins are within 1 mile of the four transmission line alternatives. Most of these properties are within 0.5 mile of U.S. 2.

Table 136. Summary of Ambient Sound Measurements.

Measurement Period	Little Cherry Creek Impoundment Site	Ramsey Plant Site
Midweek		
Day (L_d)	39.0	41.3
Night (L_n)	35.5	28.8
Average 24-hour (L_{dn})	42.6	40.5
Weekend		
Day(L_d)	28.6	40.1
Night (L_n)	22.7	31.3
Average 24-hour (L_{dn})	30.6	40.6

Source: Woodward-Clyde Consultants, Inc. 1989a.

3.19.4 Environmental Consequences

3.19.4.1 Sound

3.19.4.1.1 Alternative 1 – No Mine

The analysis area would continue to have quiet sound levels characteristic of rural areas and wilderness lands. Existing noise levels would not change. Activities on private land at the Libby

Adit Site would remain until reclaimed in accordance with existing permits and approvals. These activities would increase ambient noise levels near the adit.

3.19.4.1.2 Alternative 2 – MMC's Proposed Mine

Construction Phase

During the construction phase, noise would be produced by heavy equipment, such as scrapers, bulldozers, graders, loaders, and rock trucks. The noise produced by diesel-powered equipment typically is 85 dBA at a distance of 50 feet from the equipment. Equipment noise can vary considerably depending on age, condition, manufacturer, use during a time period, and a changing distance from the equipment to a listener location. To minimize equipment noise, MMC would supplement backup beepers on surface equipment with strobe light-type warning devices and the sound level of the backup beepers would be reduced to the minimum level necessary to comply with safety regulations.

Generators would be used to supply power as the adits were developed, and each generator is predicted to produce a noise level of about 82 dBA at 50 feet. Ventilation fans would be located outside of the portals, and include inlet and discharge attenuators to meet a total noise level of 85 dBA at 3 feet (Big Sky Acoustics 2006). Noise from the generators and fans would extend into the CMW, reaching about 30 dBA along the ridge between Elephant Peak and Eagle Peak (Big Sky Acoustics 2006). These sound levels in the CMW would be slightly above existing levels, affecting recreational users of this portion of the CMW. Noise from generators would cease after 2 to 3 years when the transmission line was completed.

Highest noise levels would be generated periodically at the Ramsey Plant Site as a result of blasting. Blasting noise near the surface during the preproduction phase is predicted to be equal to 122 dBA at 0.6 mile from the Ramsey Plant Site, and equal to the existing ambient noise level at up to about 8 miles from the site. Blasting noise would be greatest during initial adit construction; as the adits go deeper, blasting noise would decrease. The Rock Lake Ventilation Adit would be constructed from the mine to the surface. Very short-term blasting would be necessary when the adit daylighted on private land east of and above Rock Lake.

Construction phase activities also would include: hauling of waste rock to the Little Cherry Creek Impoundment Site; excavation of borrow material from the Little Cherry Creek Impoundment Site; and construction of a Starter Dam, Diversion Channel and Seepage Collection Dam at the Little Cherry Creek Impoundment Site. Noise levels between 30 and 40 dBA would be experienced in areas within 2.5 miles of the source, depending on the topography and atmospheric conditions. Some blasting may be necessary in the upper part of the diversion channel. Elevated noise levels from blasting would be short and intermittent.

Construction truck traffic over a 1-year period to and from the Plant Site, Tailings Impoundment Site, and Libby Loadout would increase noise levels on the Libby Creek Road (NFS road #231) while the Bear Creek Road is reconstructed. Trucks with properly operating mufflers would be expected to generate up to an estimated 86 dBA at 50 feet. Trucks using Jake brakes with straight pipe mufflers would produce sound levels of 98 dB(A) at 50 feet, and would be audible at distances of up to 1 mile. Similar noise levels would occur along the Bear Creek Road (NFS road #278) during the construction period. The noise effects would be similar to those of trucks transporting logs from a timber sale. These haul trucks would affect residences adjacent to the access road.

Operations Phase

Noise at the Ramsey Plant Site would be slightly less during operations than during the construction phase. Ore would be processed inside the mill buildings. Noise from enclosed milling operations is typically audible as a low level hum, and was measured as 49 dBA at about 328 feet near the Troy Mine plant (Big Sky Acoustics 2006). Noise levels greater than the EPA guideline of 55 dBA would occur in the immediate vicinity of the Ramsey Plant Site, but would decrease substantially with distance from the mill. For example, noise levels at the Troy Mine were 49 dBA 330 feet from the mill. Noise levels between 30 and 55 dBA would extend into the CMW to Elephant Peak and down the Ramsey Creek drainage to about the LAD Area 1 (Big Sky Acoustics 2006). At all project facilities, backup beepers on surface equipment would be supplemented with strobe light-type warning devices. The sound level of the backup beepers would be reduced to the minimum level necessary to comply with safety regulations. These sound levels in the CMW would be slightly above existing levels, affecting recreational users of this portion of the CMW.

The fan associated with the Rock Lake Ventilation Adit would be located inside the mine, and not at the portal. The walls of the raise and adit would reduce the noise from the fan at the surface. Noise level at the portal of the Rock Lake Ventilation Adit is estimated to be 16 dBA and would not be audible over ambient noise levels (Big Sky Acoustics 2006).

Noise at the Little Cherry Creek Impoundment Site and LAD Areas would be generated by heavy equipment during construction and by occasional vehicular traffic, pumps and associated equipment, and bulldozers during operations. The sound from bulldozers would be periodic. In general, the production phase noise levels are predicted to be equal to 55 dBA within about 0.2 mile of the facility, and would be equal to the lowest measured existing ambient noise level of 30 dBA within about 2.5 miles of the sites (Big Sky Acoustics 2006).

Truck and train traffic and heavy equipment would increase noise at the Libby Loadout. Loadout activities would generate sound levels similar to other operations. The increased noise levels would be less noticeable because of higher ambient noise levels.

Closure Phase

After operations cease, MMC would remove all facilities from the plant and adit sites. Reclamation at the Ramsey Plant Site, the Libby Adit Site, and the Rock Lake Ventilation Adit Site would take several years. Noise at these locations would be generated by heavy equipment during reclamation and by occasional vehicular traffic. Heavy equipment also would be used at the tailings impoundment. The decommissioning and closure period is expected to require a minimum of 10 years, and possibly up to 25 years of monitoring (Klohn Crippen Consultants 2005). Reclamation activities would generate sound levels similar to the operations phase. At the end of reclamation, noise levels at all project facilities would return to pre-mine levels. Traffic and activities associated with any long-term monitoring or water treatment would generate slightly increased noise levels.

3.19.4.1.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Noise sources and general magnitude of effects during all phases of operations in Alternative 3 would be similar to Alternative 2. Ventilation adits would be in Libby Creek and near Rock Lake. During construction of the adits, elevated noise levels would extend up and down the Libby Creek drainage in a similar manner as in Ramsey Creek in Alternative 2. Noise from the generators and fans would extend into the CMW, reaching about 30 dBA along the ridge between

Elephant Peak and Ojibway Peak. Noise from generators would cease after 2 to 3 years when the transmission line was completed.

Construction of the Libby Plant Site would increase noise levels in the lower Ramsey Creek drainage and in the Libby Creek drainage east of the Libby Adit. Recreational users at the Libby Gold Panning Recreation Area would experience noise levels between 45 and 55 dBA.

3.19.4.1.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Noise sources and general magnitude of effects during all phases of operations at the Libby Plant Site, Upper Libby Adit Site and LAD Areas 1 and 2 in Alternative 4 would be the same as in Alternative 3. Noise effects at the Little Cherry Creek Impoundment Site would be the same as Alternative 2.

3.19.4.1.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Noise levels associated with the existing 345-kV BPA transmission line would not change. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.19.4.1.6 Alternative B – MMC's Proposed Transmission Line

Noise During Transmission Line Construction, Operations, and Decommissioning

Transmission line construction would temporarily increase daytime ambient noise levels along the transmission line corridor. During the estimated 6-month transmission line construction period, construction equipment such as bulldozers, loaders, and haul trucks would generate 100 to 120 dB(A) at 50 feet. Chain saws and logging trucks used in forest clearing for the line would generate similar noise levels. These sounds would generally occur in hilly, forested areas, which would serve to reduce sound audibility. A helicopter may be used for four activities, depending on the construction contractor, structure placement, line stringing, timber harvest, and annual inspection and maintenance. Helicopters may be used for logging steep terrain. Logging may take one to two months, depending on the area logged. Structure placement and line stringing would take a week or two each. Annual inspections may take about a week. Increased noise levels would be audible residences along U.S. 2, residences along West Fisher Creek and Standard Creek (Figure 78) and recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment of this alternative. Similar helicopter noise would be audible during annual inspections of the line. When the line and structures were removed at mine closure, noise from helicopters, vehicles and other heavy equipment would be audible residences along U.S. 2 and recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment. Some residents may perceive air pressure changes as vibrations from the helicopter use.

Because of generally low ambient background noise levels, the transmission line clearing, road construction, and line construction activities would be generally audible for about 2.5 miles, depending on the topography and atmospheric conditions. This could include the campground at Howard Lake and homes and recreational use areas along the Fisher River Valley. Equipment trucks or logging trucks could extend the audible area. All off-site truck traffic would temporarily

increase noise levels at residences adjacent to travel routes to and from the construction area. The effects would be similar to logging trucks transporting logs from an active timber sale area. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity was completed.

Transmission Line Noise

The proposed 230-kV electrical power transmission line would produce soft hissing and crackling sounds in wet weather. In fair weather, these noises are virtually inaudible. During the light rains or wet snows which occur about 10 percent of the time in the analysis area, the transmission line would produce a noise level of about 50 dB(A) at the edge of the right-of-way (Power Engineers 2005a). The closest residence to MMC's proposed centerline would be about 380 feet; two other residences along U.S. would be between 400 and 500 feet from the centerline. The proposed centerline may vary up to 250 feet from the final centerline in final design. Expected noise levels at a residence about 380 feet from the centerline during a light rain or wet snows would be between 40 and 45 dBA (Power Engineers 2005a). This sound level would be slightly above naturally occurring levels and would be faintly discernible. The sound level would be less than 20 dBA during fair weather, and would not be audible over existing sounds. Because BPA's Sedlak Park Substation would not contain a transformer, there would be no audible hum emanating from the substation. Whenever breakers were to open and close, an audible noise would be heard by those in close proximity to the substation. The noise would be infrequent, occurring no more than a few times per year, and would be no louder than the noise from a shotgun blast.

3.19.4.1.7 Alternatives C, D, and E – Other Transmission Line Alternatives

Noise Transmission Line Construction, Operations, and Decommissioning Noise

Noise sources and general magnitude of effects during all phases of construction operations, and decommissioning in Alternatives C, D and E would be similar to Alternative B. Noise associated with BPA's Sedlak Park Substation also would be the same as Alternative B.

Selected structures would be constructed and timber harvested with helicopter. Depending on the alternative, noise levels in the upper part of the Miller Creek tributary (Alternative C), Miller Creek (Alternative D) and along West Fisher Creek and Standard Creek (Alternative E) would experience noise from helicopters, heavy equipment, and chain saws between the work location and staging area during construction. Similar noise levels would be audible during annual inspections, and final line decommissioning. Helicopters would be used for five activities: logging, structure placement, line stringing, and annual inspection and maintenance, and decommissioning. Logging may take one to two months and structure placement and line stringing would take a week or two each. Annual inspections may take about a week. Increased noise levels would be audible at private residences along U.S. 2 where the alignment crosses the Fisher River, and at a private residence along West Fisher Creek in Alternative E. In Alternatives C, D and E, recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment would experience higher noise levels during construction, annual inspections, and decommissioning. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity is completed.

The alignment in the Miller Creek and West Fisher Creek Alternatives would follow NFS road #231 east of Howard Lake. At the closest location, the alignment in these two alternatives would be about 1,300 feet east of the Howard Lake Campground and about 1,000 feet east of the eastern shore of Howard Lake. Recreational users at the campground and Howard Lake would experience

higher noise levels during construction, annual inspections, and decommissioning. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity is completed.

Transmission Line Noise

No residences are within 500 feet of the centerline of the Modified North Miller Creek or Miller Creek Alternatives. Two residences are within 500 feet of the West Fisher Creek Alternative; both would be between 350 and 400 feet from the centerline. Expected noise levels at a residence 350 to 500 feet from the centerline during a light rain would be between 35 and 40 dBA (HDR Engineers 2007) and probably would not be noticeable over existing noise levels.

3.19.4.2 Electrical and Magnetic Fields

3.19.4.2.1 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Existing electrical and magnetic fields associated with the existing 230-kV BPA transmission line would not change. If existing residences are typical of others in the United States, average residential electric fields would be less than 10 V/m and magnetic fields of the order of 1 mG or less. EMFs of these levels are not known to have the potential for an adverse effect on health. Under this alternative, the residences would have no recognized potential of an EMF health impact.

3.19.4.2.2 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Within 0.5 mile of this alignment, 14 residences are present, of which 11 are greater than 450 feet from the centerline of the ROW and the remaining three are within 450 feet. Because the final alignment could vary by up to 250 feet of the centerline analyzed in this EIS (ARM 17.20.301 (21)), three residences may be within 200 feet of the centerline depending on final transmission line alignment. At lateral distances from the edge of the ROW (50 feet from the centerline) to 200 feet away, the electric field strength would range from about 0.75 kV/m at 50 feet to about 0.05 kV/m (or 50 V/m) at 200 feet. The magnetic field strength would be about 4 mG at 50 feet and less than 1 mG at 200 feet. This maximum electric strength at 50 feet would be below the level set by Montana regulation for electric field strength and both the electric and magnetic field strengths at 50 feet would be below the exposure levels for the general public recommended as reference levels or maximum permissible levels (Asher Sheppard Consulting 2007).

3.19.4.2.3 Alternatives C, D, and E – Other Transmission Line Alternatives

The seven residences along the Modified North Miller Creek Alternative and the eight residences along the Miller Creek Alternative within 0.5 mile are greater than 450 feet from the centerline. The electric field strength would be less than about 0.05 kV/m (or 50 V/m) and the magnetic field strength would be less than 1.0 mG. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the general public, and the current state of scientific research on EMFs, these alternatives are categorized as having no recognized potential for a health impact from exposure to EMFs (Asher Sheppard Consulting 2007).

Seven residences are within 0.5 mile of the West Fisher Creek centerline, of which five are more than 450 feet from the centerline and the remaining two are within 450 feet of the centerline. As part of this alternative, the centerline would be not closer than 200 feet from any residence during

final design. For residences 200 feet or more from the centerline, the electric field strength would be about 0.05 kV/m (or 50 V/m) and the magnetic filed strength would be less than 1 mG. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the general public, and the current state of scientific research on EMFs, the alternative is categorized as having no recognized potential for a health impact from exposure to EMFs (Asher Sheppard Consulting 2007).

3.19.4.3 Radio and TV Effects

3.19.4.3.1 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Radio and TV interference associated with the existing 230-kV BPA transmission line would not change.

3.19.4.3.2 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The transmission line would generate radio noise that may interfere with AM radio and television reception close to the line. FM broadcasts and 2-way communications generally would not be affected. The effect of the line on AM radio and TV interference would decrease rapidly as distance from the line increases. The closest residence to the North Miller Creek Alternative is 380 feet from the proposed centerline, west of U.S. 2 (Asher Sheppard Consulting 2007). Under Montana's regulations, the proposed centerline may vary up to 250 feet from the final centerline in final design. The calculated radio interference at the closest residence of MMC's proposed centerline (380 feet) would be between 40 and 45 dBμV/m for the rain-weather condition and around 25 dBμV/m for the fair-weather condition. The calculated television interference at the closest residence (380 feet) would be about 8 dBμV/m for the rain-weather condition. A guideline for radio noise is a fair-weather level of about 40 dBμV/m at a lateral distance of 100 feet from the outermost phase (Power Engineers, Inc. 2006a).

If interference were to occur once the line was energized, MMC or the operating utility would correct the interference as required by FCC regulations and the Environmental Specifications (Appendix D). Correction of interference would depend on site-specific circumstances. According to FCC regulations, the line must not degrade radio or TV reception beyond current levels. Typically, changes in line operation or measures such as installation of remote antennae correct most interference problems (Power Engineers, Inc. 2006a). Possible radio and TV interference problems along the transmission line typically cannot be accurately identified until the final line location and design are known.

3.19.4.3.3 Alternatives C, D, and E – Other Transmission Line Alternatives

The three other transmission line alternatives would use the eastern alignment and route the line east of the homes along U.S. 2. The Modified North Miller Creek alignment has no residences within 500 feet of the centerline; therefore, effects on radio and TV would not occur. The Miller Creek Alternative has one residence and the West Fisher Creek Alternative has two residences between 350 and 500 feet of the centerline. The effects on radio and television interference of the other transmission line alternatives would be similar to the North Miller Creek Alternative.

3.19.4.4 Cumulative Effects

Past actions and current actions, such as the activity at the Libby Adit Site, and vehicular traffic and NFS roads, have increased ambient noise levels over that of an undisturbed forest. The existing BPA transmission line also has EMF near the line. The KNF's Miller-West Fisher Vegetation Management Project will consist of vegetative treatments including timber harvest, slash treatment, site preparation, prescribed burning, tree planting, precommercial thinning, construction of new roads, road storage and decommissioning activities, road reconstruction, and implementation of best management practices. Depending on the timing of these activities and construction of the transmission line, noise from equipment and helicopters may be cumulatively greater in the Miller Creek and West Fisher Creek drainages. Many of the reasonably foreseeable actions would use the same roads as the Montanore Project. The reasonably foreseeable actions and the Montanore Project would cumulatively increase traffic noise near access roads. Cumulative noise levels would unlikely to exceed 55 dBA.

3.19.4.5 Regulatory/Forest Plan Consistency

The applicable Montana administrative rules require that the electric field strength at the edge of the ROW be no greater than 1 kV/m in residential and subdivided areas and at road crossings be no greater than 7 kV/m. Calculations performed under assumptions of line operating conditions that would produce maximum strength electric and magnetic fields do not exceed these restrictions (Power Engineers 2005a, HDR Engineers 2007). Montana has no rule or regulation concerning 60-Hz magnetic fields of power lines. Montana also requires that transmission lines be constructed in conformity with the National Electric Safety Code. All proposed transmission line alternatives would meet this requirement. In addition, MMC would be required to prevent unacceptable interference with stationary radio, television, and other communication systems as a condition of the certificate. In summary, all transmission line alternatives would comply with Montana rules concerning EMF levels and transmission line safety.

3.19.4.6 Irreversible and Irretrievable Commitments

The quiet sound levels characteristic of the analysis area would be irretrievably lost during the construction, operations, and closure phases.

3.19.4.7 Short-term Uses and Long-term Productivity

Elevated noise and EMF levels in all action alternatives would cease at mine closure and transmission line decommissioning, and would be a short-term use of the existing environment.

3.19.4.8 Unavoidable Adverse Environmental Effects

Elevated noise levels in upper Libby Creek would occur during the reclamation of the Libby Adit in the No Action Alternative. Similar noise levels would occur during construction, operations, and reclamation would occur between Libby Creek and the Cabinet Mountains in all mine action alternatives. Elevated noise from equipment and helicopter use in drainages in which the transmission line would be built would occur in all transmission line action alternatives.

3.20 Transportation

The transportation resource consists of a network of roadways that would be used during activities related to the proposed mine and transmission line. This section discusses the effects on roadway level of service and safety. Effects on public access in the analysis area have been discussed in section 3.15, *Recreation*.

3.20.1 Regulatory Framework

The roads analysis complies with regulations governing the administration of the Forest Transportation System (36 CFR 212) and with the Forest Service Transportation Administrative Policy FSM Chapter 7700 (2001). The Forest Service regulations intended to help ensure that additions to the National Forest System road network are those deemed essential for resource management and use; that construction, reconstruction, and maintenance of roads minimize adverse environmental impacts; and that unneeded roads are decommissioned and restoration of ecological processes are initiated. Current Forest Service roads policy requires a science-based transportation analysis (USDA Forest Service 1999a).

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Goals, objectives, and standards that apply to Forest System Roads (roads wholly or partly within or adjacent to and serving the National Forest System and which are necessary for the protection, administration and utilization of the National Forest System and the use and development of its resources) are discussed below. Applicable general Forest-wide goals and objectives address road densities, soil erosion, and water quality concerns. Applicable KFP standards governing roads are that development activities will be rigorously examined to insure that the minimum number and length of roads are constructed to the minimum standard necessary. The KFP, which incorporates INFS standards, establishes stream, wetland, and landslide-prone area protection zones called RHCAs, and set standards and guidelines for managing activities that potentially affect conditions within the RHCAs. INFS standards applicable to roads have been discussed in section 3.6, *Aquatic Life and Fisheries.*

3.20.2 Analysis Area and Methods

3.20.2.1 Analysis Area

In Alternative 2, MMC would use U.S. 2, NFS road #278 (Bear Creek Road), 1.7 miles of new access road, and NFS road #4781 (Ramsey Creek Road) to access the plant site and tailings impoundment. About 10 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Bear Creek bridge, would be paved with chip-seal and upgraded to 20 to 29 feet wide. U.S. 2 would be used from Libby, Montana (U.S. 2 milepost (MP) 32.7) to the intersection with Bear Creek Road (MP 39.7). Approval of the approach road to the Libby Loadout in Libby, the Bear Creek Road/U.S. 2 intersection, and to the Sedlak Park Substation (MP 60.3) in the right-of-way of Montana Department of Transportation (MDT) and under its jurisdiction. NFS road #6210 (between Ramsey Creek and Libby Creek) would be used as an access road to the Libby Adit. While the Bear Creek Road is upgraded in the first 2 years, NFS road #231 (Libby Creek Road) would be used for access.

In Alternatives 3 and 4, MMC would use the same segment of U.S. 2 between Libby and the intersection with Bear Creek Road, and the Bear Creek Road to the tailings impoundment site. As

in Alternative 2, the Bear Creek Road would be paved with chip-seal and upgraded to 26 feet wide. New segments of access road would be needed.

During transmission line construction, MMC would use U.S. 2 from Libby to Sedlak Park (MP 58.8). Depending on the transmission line alternative selected, MMC would use other NFS roads, such as the Miller Creek Road (NFS road #385), or the Libby Creek Road (NFS road #231). Proposed road use and new road construction in each transmission line alternative is discussed in Chapter 2. None of the new roads would be open to public access and only used for access to the transmission line. Effects of the new roads are discussed where appropriate in various resource sections, such as sections 3.14, *Land Use;* 3.18, *Soils and Reclamation;* 3.21, *Vegetation;* and 3.24, *Wildlife Resources*.

No airports, air strips, helipads, or metal pipelines are in the analysis area; these areas are not discussed further. Ken Justice, a pilot with the ALERT Air Ambulance Service at the Kalispell Regional Medical Center indicated U.S. 2 is not used as a corridor for helicopters and that the preferred route is the Kootenai River corridor (Justice 2008). No railroads are near the mine area or transmission line corridors. Concentrate would be shipped via rail from the Libby Loadout. MMC's concentrate shipments would be very small, and effects on rail traffic are not discussed further.

3.20.2.2 Methods

To establish the base traffic conditions, the amount of traffic on the roadway system during the time period of the proposed mine operations without mine-related traffic was estimated. The proposed mine traffic was then added to the base levels, and the extent to which the mine traffic affects the service level of the roadway network was then determined. Safety was analyzed by calculating the additional number of accidents that may result from the increases in mine-related traffic. Intersections within the roadway network were examined to determine if the roadways need to be modified to accommodate increased levels of traffic. Because transmission line access roads would be used most heavily during construction and line decommissioning, and traffic volumes relatively would be small and short-term, an assessment of traffic congestion and safety was not completed on them.

3.20.2.2.1 Time Period

The analysis area includes the roadways to be used by mine traffic during start up, operating, and reclamation phases. For purposes of analysis, the lead agencies assumed construction would start in 2010. Mine start up construction activities would last 3 years until 2013. The mine would operate until 2029, for 16 years. Three additional years of operation may occur.

After operations are completed, the mine would be closed. Reclamation and monitoring activities would last 10 years, until 2039. Upon completion of mining operations, traffic volumes would be greatest during the first year for reclamation activities. Traffic would be minimal during post-closure monitoring activities. The analyses were projected for 19 years, starting in 2010. Although actual timelines for the mine may change from the timeline proposed (for example, if construction would start in 2012 instead of 2010), the magnitude and duration of the effects of mine-related traffic on the transportation system would remain relatively the same.

3.20.2.2.2 Traffic Volumes

MMC provided estimates of mine-related daily traffic volumes and vehicle types anticipated to use the roadway system during operation of the proposed mine (MMI 2005a, MMC 2008). The MDT and the KNF provided traffic data for U.S. 2 and National Forest System roads. MMC's volumes and types were added to the traffic data supplied by the MDT and the KNF. In addition to traffic data, the MDT supplied design plans for the segments of U.S. 2 from Libby to the Libby Creek Road turnoff; these design plans were used to complete the intersection safety analysis at U.S. 2 and Bear Creek Road.

3.20.2.2.3 Traffic Congestion

The quality of service that a roadway provides is a measure of the amount of traffic congestion on a roadway for a particular volume of traffic. The quality of service is measured using the concept of levels of service (LOS). Six LOSs are as defined by the Transportation Research Board (TRB) in the Highway Capacity Manual. The six LOSs are A, B, C, D, E, and F, with LOS of A being the least congested, or best condition, and LOS of F being the most congested, or worst condition. Any roadway section determined to be functioning at LOS A, B or C is considered to be operating acceptably (Highway Capacity Manual 2000).

An LOS analysis was completed for U.S. 2 and for the intersection of U.S. 2 and Bear Creek Road. These analyses were completed for peak hour traffic during the day and represent the maximum amount of traffic congestion expected. For most of the time, the roadways would not experience the peak hour traffic used in the analysis.

For two-lane highways, such as U.S. 2, each LOS is defined by percent time spent following another vehicle and average travel speed, as shown in Table 137. U.S. 2 is a class 1 highway, which is as a highway where efficient mobility is paramount. For intersections without traffic lights, such as the two-way, stop-controlled (TWSC) intersection at U.S. 2 and Bear Creek Road, each LOS is defined by a range of delay times, measured in seconds that an individual vehicle will experience completing an individual turning movement during the peak hour volume (Highway Capacity Manual 2000). The LOS criteria for TWSC intersections are also shown in Table 137. The intersection of U.S. 2 and the Libby Loadout access road was not analyzed due to the low level of anticipated use by MMC-related vehicles, which would be about one truck per hour during day shift operating hours.

The intersections of U.S. 2 and Libby Creek Road and U.S. 2 and the proposed Sedlak Park substation access did not warrant analysis because the limited amount of traffic that would use them during construction activities would not affect the operation of the intersection. Congestion on Bear Creek Road and Libby Creek Road also was not analyzed because the Highway Capacity Manual analysis methods do not apply to recreational roads. A recreational road is not used for mobility, or to get from point A to point B in the fastest time, which is the basis of the two-lane highway analysis in the Highway Capacity Manual.

3.20.2.2.4 Safety

The safety of a particular section of highway is measured by the number of crashes per million vehicle miles traveled, called the accident rate. Typically, if there are no changes to a portion of highway that could affect the number of crashes and the roadway congestion is not severe, then as the amount of traffic increases, the number of accidents also increases proportionally by the accident rate. Because the proposed mine project would result in increased traffic on the area

roadways, the number of accidents also may increase. The additional number of accidents that may result from the mine-related traffic was calculated for existing and future traffic conditions.

The intersection of U.S. 2 and Bear Creek Road also was analyzed to determine if the intersection met current sight distance requirements and if turning lanes were required based on additional mine-related traffic. The sight distance and turning lane requirements for the intersection were analyzed using current MDT design criteria from the Montana Road Design Manual (MDT 2000).

Table 137. Level of Service Criteria Used in Congestion Analysis.

Level of Service	Criteria for Two-Lane Highways in Class 1		Criteria for TWSC Intersections
	Percent Time Spent Following	Average Travel Speed (mph)	Average Control Delay (sec/vehicle)
A	< 35	> 55	0 to 10
B	> 35 to 50	> 50-55	>10 to 15
C	> 50 to 65	> 45 to 50	>15 to 25
D	> 65 to 80	> 40 to 45	>25 to 35
E	> 80	> 40	> 35 to 50
F	Applies whenever the flow rate exceeds the segment capacity		> 50

TWSC = two-way, stop-controlled.
Source: Highway Capacity Manual 2000.

3.20.3 Affected Environment

3.20.3.1 U.S. 2

U.S. 2 is a Non-Interstate National Highway and the northernmost U.S. highway. It provides access for eastbound and westbound travel across the continental United States. In Montana, the MDT classifies U.S. 2 as a principle arterial.

Average annual daily traffic (AADT) volumes at three locations along U.S. 2 near the intersection of U.S. 2 and NFS road #278 (Bear Creek Road) from 1997 through 2004 were provided by the MDT (Table 138). The data were used to develop traffic growth rates for each section of roadway in the analysis. The AADTs increase toward the city of Libby and more than double from the east side of the intersection with State Highway 482 (MP 36.0) in the town of White Haven to the west side (MDT 2006).

Within the analysis area, from the city of Libby (MP 32.7) to the intersection with Montana Highway 482 in the city of White Haven (MP 36.1), U.S. 2 is a two-way, four-lane, undivided highway with a total width of 68 feet. The road consists of 12-feet travel lanes, 10-feet shoulders, and is bounded on both edges by curb and gutter. South of the intersection with Highway 482, U.S. 2 reduces in width to a two-way, three-lane, undivided highway. The eastbound direction remains at two lanes to MP 36.6. The westbound direction is a single travel lane. The roadway

edges change from a curb and gutter to a shoulder and ditch section. At MP 36.6, U.S. 2 reduces to a two-way, two-lane highway that is a total width of 46 feet and consists of 12-feet travel lanes and 11-feet shoulders. The shoulder width remains 11 feet until MP 37.4, where it reduces to 1.5 feet. The narrow shoulder condition continues to Libby Creek Road.

Table 138. Average Annual Daily Traffic on U.S. 2 near the Bear Creek Road Intersection.

Milepost/ Year	Average Annual Daily Traffic (vehicles/day)							
	1997	1998	1999	2000	2001	2002	2003	2004
35.3	4,920	5,940	8,260	4,800	4,800	5,290	5,270	5,660
37.5	2,470	2,140	3,820	2,060	No Data	2,350	2,220	2,290
40.0	1,570	1,410	1,220	1,740	2,000	1,740	1,550	1,880

Note: 1997 to 1999 data at MP 35.3 and 37.5 not used in analysis due to anomalously high fluctuations
Source: MDT 2006.

Proceeding east from the city limit boundary for the town of Libby, the posted regulatory speed limit is 40 mph to MP 33.4 (0.6 mile), increases to 50 mph to the end of the three-lane roadway section at MP 36.4 (east of White Haven), and increases to 70 mph for passenger vehicles, and 65 mph for trucks on the remainder of the two-lane roadway within the analysis area. The roadway surface is asphalt. Based on roadway plans provided by MDT, the roadway geometry is curvilinear and the terrain is level between Libby and White Haven and rolling east of White Haven. Initially constructed in the 1930s, the road was resurfaced and rehabilitated in 1998 and 1999.

Accident information including accident rates for U.S. 2 from MP 32.7 to MP 40.0 was supplied by MDT. Accident information is presented in Table 139. The accident rate for U.S. 2 between MP 32.7 to MP 40 is 1.12 accidents per million vehicle miles traveled for the 7-year period 2001 to 2007. The accident rate for all rural non-interstate national highways in Montana from 2000 to 2004 was 1.24 accidents per million vehicle miles traveled. From 2001 to 2005, one accident occurred at the intersection of U.S. 2 and Bear Creek Road. It was a single vehicle accident that involved a right turning vehicle that lost control. At the time of the crash, the roadway surface was snow packed (Jomini 2006a, 2006b). No data for crash rates on Bear Creek Road or Libby Creek Road are available.

3.20.3.2 NFS Road #278 (Bear Creek Road)

Bear Creek Road intersects U.S. 2 at MP 39.7, 7.0 miles east of the Libby city limit boundary. It functions primarily as a recreational road, providing access to the KNF. The first 0.75 mile of Bear Creek Road is a two-way, two-lane roadway with a total width ranging from 18 to 20 feet. The remainder of the roadway is two-way, single-lane with a total width of about 14 feet. The first 9.5 miles has a chip-seal paved surface that is in poor condition. Bear Creek Road crosses Bear Creek at MP 9.5; the bridge across Bear Creek is 14 feet wide. The remainder of the road is a native (dirt) surface. The roadway geometry is curvilinear with various curves in several locations. The roadway profile is mountainous.

Table 139. U.S. 2 Accident Data (MP 32.7 to MP 40.0).

Year	Total Number of Crashes	Total Number of Fatal Crashes	Total Number of Injury Crashes	Total Number of Property Damage Only Crashes
2001	11	0	6	5
2002	13	0	9	4
2003	17	0	4	13
2004	8	0	3	5
2005	11	0	7	4
2006	15	1	7	7
2007	18	0	6	12
Total	93	1	42	50

MP = milepost.
Source: Jomini 2006a, 2006b.

Because the roadway is not an all-weather road (Stantus, pers. comm. 2006b), it is closed during spring frost break-up for vehicles weighing over 10,000 pounds. All types of vehicles can travel on the roadway except when mud and snow conditions limit use to 4-wheel drive (USDA Forest Service *et al.* 1992). There has been little maintenance to the roadway and several areas of the roadway have settled due to subsurface instability.

Yearly traffic volumes supplied by the KNF from 1986 through 1991 (Table 140) were used to develop traffic growth rates and peak hour traffic volumes. ADT volumes from 1986 through 1990 also were provided by the KNF based on grizzly bear seasons: spring (April 1 to June 15), summer (June 16 to September 15), and fall (September 16 to September 30) (Table 140) (Lampton, pers. comm. 2006). According to the KNF, the actual existing volumes are likely lower than the provided volumes due to significant decreases in timber operations since 1991(Lampton, pers. comm. 2006).

Table 140. Estimated Yearly Traffic on Bear Creek Road.

Year	Traffic Volumes (vehicles/year)	Average Daily Traffic Based during Grizzly Bear Seasons (vehicles/day)[†]			
		Spring 4/1 - 6/15	Summer 6/16 - 9/15	Fall 9/16 - 9/30	Winter 10/1 - 12/31
1986	15,957	47	72	82	88
1987	18,773	40	80	96	107
1988	13,175	38	80	65	70
1989	17,355	50	88	98	87
1990	19,150	53	101	88	103
1991	13,615	47	72	69	72

[†]No traffic data were provided from January 1 to May 31.
Source: Stantus 2006a; Lampton 2006.

3.20.3.3 NFS Road #231 (Libby Creek Road)

Libby Creek Road intersects U.S. 2 at MP 42.0, 9.3 miles east of the Libby city limit boundary. It functions as a recreational road providing access to the KNF. Libby Creek Road has a two-way, two-lane width of 22 feet and a chip-seal paved surface for the first 0.5 mile. The road then narrows to a two-way, single-lane width varying from 14 to 16 feet with a gravel surface until the bridge at MP 9.2 (Lampton 2006). The speed limit in this section is 25 mph and the degree of intervisible turnouts is 75 percent; an intervisible turnout is an area designed to allow vehicles to pass and so spaced to provide visibility between the turnouts. At MP 9.2 (intersection with Bear Creek Road) and proceeding until MP 10.6, the road changes to a two-way, single-lane width of 12 feet and maintains the gravel surface. The speed limit is 20 mph and the degree of intervisible turnouts is 50 percent. From MP 10.6 to the end of the road, the roadway surface is native and the two-way, single lane roadway width is 12 feet. The speed limit is 15 mph and there are no intervisible turnouts (USDA Forest Service *et al.* 1992). The roadway geometry is curvilinear with very sharp curves in several locations. The roadway profile is mountainous.

The Libby Creek Road is not built to an all-weather standard and, like Bear Creek Road, is closed during spring frost break-up to vehicles weighing over 10,000 pounds. All vehicles can generally use the roadway except during snow and mud conditions when travel is limited to 4-wheel drive (USDA Forest Service *et al.* 1992). Culverts and surfacing have been replaced in the last 5 years (Stantus 2006b).

3.20.4 Environmental Consequences

3.20.4.1 Congestion

3.20.4.1.1 Alternative 1 – No Mine

Without the proposed mine, traffic on U.S. 2 from White Haven to Bear Creek Road would grow at an annual rate of 1.2 percent, increasing from 2,460 vehicles per day in 2010 to 3,085 vehicles in 2029. This would result in peak hour traffic of 370 vehicles per hour in 2010 and 465 vehicles per hour in 2029. For the entire 19-year period from 2010 to 2029, U.S. 2 would function at LOS C in this two-lane section of the roadway, due to the limited passing opportunities and the percent of time vehicles spent following other vehicles. Between Libby and White Haven, traffic would grow at 1.2 percent annually with traffic increasing from 5,075 vehicles per day in 2010 to 6,370 vehicles per day in 2029. Peak hour traffic would be 760 vehicles per hour in 2010 and 960 vehicles per hour in 2029. This four-lane section would operate at LOS A through 2027.

The seasonal average daily traffic (SADT) on Bear Creek Road is 127 vehicles per day in 2010. Without the proposed mine, traffic would grow at an annual rate of 2.0 percent increasing to 185 vehicles per day in 2029. No improvements would be completed to Bear Creek Road under this alternative. A negligible increase in traffic volumes along the Bear Creek Road and NFS roads #4781 and #6210 would occur during ongoing activities at the Libby Adit.

Peak-hour traffic entering U.S. 2 from Bear Creek Road would experience a LOS B through 2029. The increase in traffic also would not affect peak hour traffic turning left from U.S. 2 onto Bear Creek Road. It would experience a LOS A during the entire 19-year period from 2010 to 2029.

3.20.4.1.2 Alternative 2 – MMC's Proposed Mine

The low volume of traffic generated by the proposed mine would not adversely affect the operation of U.S. 2. The proposed mine would generate an additional 132 vehicles per day on U.S. 2, including 52 trucks and six buses. U.S. 2 would continue to function at LOS C during the peak hour period in the two-lane section during the entire 19-year period from 2010 to 2029. The additional mine-related traffic also would not affect the four-lane section of the roadway, which would still function at LOS A through 2027.

The addition of mine-related traffic to the existing traffic entering U.S. 2 from Bear Creek Road in 2010 would not affect the LOS and would remain LOS B during operations. Peak hour traffic turning left from U.S. 2 onto Bear Creek Road also would not experience a reduction in LOS due to the mine-related traffic and would still operate at a LOS A.

About 10 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Bear Creek bridge, would be chip-and-seal paved and upgraded to 20 to 29 feet wide. Several short segments of the Bear Creek Road around the Little Cherry Creek Impoundment and Diversion Channel also would be realigned under this alternative. Reconstruction is anticipated to take 2 years. Public traffic and mine-related traffic required for construction of the mine facilities would use Libby Creek Road (NFS road #231) as the primary access to the KNF during the time that Bear Creek Road would be reconstructed. The reconstruction of Bear Creek Road would minimize future congestion because the roadway would be upgraded to a uniform width that would accommodate two-way traffic in separate lanes.

The Forest Service would require the MMC to obtain a road use permit prior to using Libby Creek Road during mine construction activities. The permit could include a monetary deposit for gravel replacement and conditions for dust control. Permit requirements would be determined by the level of use anticipated by MMC (Stantus 2006a).

Six roads currently open, Little Cherry Loop Road (NFS road #6212), a 1.6-mile long segment Little Cherry Bear Creek Road of (NFS road #5182), NFS road #8838, a 1-mile long segment Poorman Creek Road of (NFS road #2317), 0.2 mile of NFS road #5170, and a 0.7-mile long segment of Ramsey Creek Road (NFS road #4781), would be gated and used for mine traffic only during operations. The gates on the Little Cherry Loop Road (NFS road #6212) and the Poorman Creek Road (NFS road #2317) would be near the intersection with the Bear Creek Road on the north end and the tailings impoundment permit area boundary on the south end. Gating the Little Cherry Loop Road (NFS road #6212) would restrict motorized access to NFS roads #5182 and #8838. The gate on the Poorman Creek Road (NFS road #2317) would be near its intersection with the Bear Creek Road south of Poorman Creek. Gating the Poorman Creek Road (NFS road #2317) would restrict motorized access to the Ramsey Creek Road (NFS road #4781) and NFS road #5170.

At the end of operations, gates on formerly open roads would be removed and the roads would reopen to motorized access. A segment of the Little Cherry Loop Road (NFS road #6212) would be covered by the tailings impoundment and would not provide a loop between the Bear Creek Road. Traffic on the segment of the Bear Creek Road between Poorman and Bear creeks would increase over the long term due to the loss of the Little Cherry Loop Road beneath the impoundment.

3.20.4.1.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would have similar effects on congestion and level of service as Alternative 2. The addition of mine-related traffic to the existing traffic entering U.S. 2 from Bear Creek Road in 2010 would maintain LOS B during operations. Creation of a supply staging area in Libby and consolidating shipments to the mine area would slightly reduce traffic from that estimated for Alternative 2.

The public and mine traffic would use the new Libby Plant Access Road (Figure 30). The abandoned Bear Creek Road (NFS road #278) between the Libby Plant Access Road and just north of Poorman Creek would be gated during operations and decommissioned at closure. The gates on the Little Cherry Loop Road (NFS road #6212) would be near the tailings impoundment permit area boundary on the north end and near its intersection with the Bear Creek Road south of Poorman Creek on the south end. The existing bridges across Poorman Creek on the Bear Creek Road (NFS road #278) and the Little Cherry Loop Road (NFS road #6212) would be removed at closure. Connection between the Bear Creek Road and the Libby Creek Road (NFS road #231) would be maintained via the new Libby Plant Access Road and the Poorman Creek Road (NFS road #2317).

The Poorman Creek Road would remain open to motorized access from the intersection with the Bear Creek Road to its current closure location at the intersection of NFS road #2317B. A small parking area would provide parking for non-motorized access up Poorman Creek.

At the end of operations, gates on formerly open roads would be removed and the roads would reopen to motorized access. A segment of the Little Cherry Loop Road (NFS road #6212) would be covered by the tailings impoundment and would not provide a loop between the Bear Creek Road. Traffic on the segment of the Bear Creek Road between Poorman and Bear creeks would increase over the long term due to the loss of the Little Cherry Loop Road beneath the impoundment. About 3.2 miles of the Ramsey Creek Road (NFS road #4781) would be barriered and closed to administrative use for grizzly bear mitigation in Alternative 3. This change would reduce administrative access to the Ramsey Creek drainage.

3.20.4.1.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would have similar effects on congestion and level of service as Alternative 2. The addition of mine-related traffic to the existing traffic entering U.S. 2 from Bear Creek Road in 2010 would remain at LOS B during operations.

The gates on the Little Cherry Loop Road (NFS road #6212) and the Poorman Creek Road (NFS road #2317) would be near the intersection with the Bear Creek Road on the north end and the tailings impoundment permit area boundary on the south end. Gating the Little Cherry Loop Road (NFS road #6212) would restrict motorized access to NFS roads #5182 and #8838.

The Poorman Creek Road would remain open to motorized access from the intersection with the Bear Creek Road to its current closure location at the intersection of NFS road #2317B. A small parking area would provide parking for non-motorized access up Poorman Creek.

At the end of operations, gates on formerly open roads would be removed and the roads would reopen to motorized access. A segment of the Little Cherry Loop Road (NFS road #6212) would be covered by the tailings impoundment and would not provide a loop between the Bear Creek Road. Traffic on the segment of the Bear Creek Road between Poorman and Bear creeks would

increase over the long term due to the loss of the Little Cherry Loop Road beneath the impoundment. About 3.2 miles of the Ramsey Creek Road (NFS road #4781) would be barriered and closed to administrative use for grizzly bear mitigation in Alternative 4. This change would reduce administrative access to the Ramsey Creek drainage.

3.20.4.1.5 Alternative A – No Transmission Line

Without the traffic related to the transmission line initial construction and continued operations and maintenance, the LOS on U.S. 2 and related roadways would operate at acceptable levels, similar to those experienced on U.S. 2 without the mine-related traffic. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.20.4.1.6 All Transmission Line Alternatives

The traffic generated by the initial construction, continued operations and maintenance and final decommissioning of any of the transmission line alternatives would have no significant effect on the traffic congestion of the affected roadways and intersections due to the low volumes of traffic generated. Short, intermittent delays on U.S. 2 would occur during transmission line stringing operations. Guard structures would be placed on either side of U.S. 2 to prevent the line from failing across the highway. Similar delays would occur and similar procedures would be used on currently open NFS roads, such as NFS road # 231 or #385, used in the construction of the transmission line. Similar short, intermittent delays on U.S. would occur during the initial months of construction of the Sedlak Park Substation Site. These delays would not adversely affect traffic congestion on U.S.

3.20.4.2 Safety

3.20.4.2.1 Alternative 1 – No Mine

By the end of 2010, between the eastern city limit of Libby to the town of White Haven, U.S. 2 is projected to have experienced an estimated 7 accidents without mine traffic. For 2010, U.S. 2 will have experienced 3 accidents from White Haven to Bear Creek Road. In 2029, the accidents between Libby and White Haven would increase to 9 accidents and 4 accidents between White Haven and Bear Creek Road. The increase in accidents would be due to the increase in traffic volumes during that same period.

3.20.4.2.2 Alternative 2 – MMC's Proposal

On U.S. 2, the proposed mine would generate an additional 132 vehicles per day over the base traffic levels without the mine and would result in an additional 0.4 accidents per year from 2010 to 2029, for a total of 8 additional accidents over the 19-year life of the proposed mine. The increased number of accidents would be due to the increase in traffic volumes, would be short-term, and would return to a number without the mine at the end of the project.

The intersection of U.S. 2 and Bear Creek Road meets current MDT sight distance requirements for left and right turning vehicles from Bear Creek Road onto U.S. 2. The intersection also meets the stopping sight distance requirements for vehicles turning from U.S. 2 onto Bear Creek Road. Turn lanes for eastbound U.S. 2 traffic turning right onto Bear Creek Road and westbound U.S. 2 traffic turning left onto Bear Creek Road would not be warranted based on the expected traffic

levels in 2010 or 2029. The Bear Creek Road is a public approach to U.S. 2. The approach would need to be evaluated for an Interstate Truck and Trailer Combination (AASHTO 2004 Greenbook WB-20 (WB-65 and WB-67)). If the approach did not meet the design requirements for a WB-67 design vehicle, modifications to the intersection would be required. The approach would be designed not to affect the transportation system level of service or safety in the analysis area.

On the Bear Creek Road and the Libby Creek Road, no accident data are available to calculate the anticipated number of accidents due to the increase in traffic from the proposed mine. On Bear Creek Road, MMC would reconstruct the segment between U.S. 2 and the Bear Creek bridge to a consistent two-lane width that is appropriate for two-way traffic to pass unobstructed. The effects of the Bear Creek Road reconstruction would eliminate any significant transportation safety impacts related to mine-related traffic. The minimal mine-related traffic on Libby Creek Road during the time period that Bear Creek Road is being reconstructed would have no adverse effect on the safety of Libby Creek Road.

MMC would reconstruct the Bear Creek Road from U.S. to the Ramsey Access Road to a roadway width of 20 to 29 feet. Mine haul traffic and public traffic would share two segments of roads, a 2.5-mile segment of the Bear Creek Road between the Little Cherry Creek Impoundment Site to the Ramsey Access Road and a 0.6-mile segment of NFS road #2316 east of the Libby Adit Site (Figure 30). MMC's proposed widths would not safely accommodate mine haul traffic and public traffic. The Mine Safety and Health Administration (Mine Safety and Health Administration 1999) recommends a road width of 56 feet wide to accommodate joint-use traffic safely.

MMC would inspect the Bear Creek bridge for load capacity, but expects it would be sufficient for mine use. The bridge width, which is currently 14 feet, would be inconsistent with the width of the improved Bear Creek Road. Because mine traffic and public traffic would share the Bear Creek Road north of the Little Cherry Creek Impoundment, the narrow bridge width may lead to safety concerns.

The Bear Creek Road between the intersection with Libby Creek Road and the new Ramsey Plant Access Road would not be reconstructed and would remain in its current unpaved condition.

3.20.4.2.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative and Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

These alternatives would have the same effect on the number of accidents on U.S. 2 as Alternative 2. Public and mine haul traffic would share 1.8 miles of road in Alternative 3 and 3.8 miles of road in Alternative 4 (Figure 39). The joint-use road segments would be widened to widths recommended by the Mine Safety and Health Administration (Mine Safety and Health Administration 1999). For a 16-foot wide haul vehicle, the road width would be 56 feet wide to safely accommodate joint-use traffic. All bridge would be reconstructed to a width compatible with the reconstructed width of the adjacent road segment. A wider road width would safely accommodate joint-use traffic. The new bridges would be long enough to convey a 100-year flow event, to comply with INFS standards. A reconstructed bridge at Bear Creek would be safer than the existing bridge.

In Alternative 3, MMC would surface the existing NFS road #278 (Bear Creek Road) from the junction with NFS road #2317 to NFS road #231 (Libby Creek Road) with 6 inches of gravel 16 feet wide (Figure 39). Similarly, would surface the Bear Creek Road from new Libby Plant access

road to the Libby Creek Road in Alternative 4 (Figure 39). This surfacing would ensure the safe transition from the improved section north of the new Libby Plant Access Road and the unimproved section to the Libby Creek Road.

3.20.4.2.4 Alternative A – No Transmission Line

Without the traffic related to the transmission line, initial construction and continued operations and maintenance, the safety on U.S. 2 and related roadways would be similar to those experienced on U.S. 2 without the mine-related traffic. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.20.4.2.5 All Transmission Line Alternatives

None of transmission line alternatives would result in adverse impacts to the safety of the transportation network due to the minimal volume of traffic that would be generated by the transmission line construction, continued operations and maintenance, and final decommissioning. The approach to the Sedlak Park Substation would be designed not to affect the transportation system level of service or safety in the analysis area.

3.20.4.3 Cumulative Effects

The KNF's Miller-West Fisher Vegetation Management Project will consist of vegetative treatments including timber harvest, slash treatment, site preparation, prescribed burning, tree planting, precommercial thinning, construction of new roads, road storage and decommissioning activities, road reconstruction, and implementation of best management practices. Depending on the timing of these activities and construction of the transmission line, traffic volumes may be cumulatively greater in the Miller Creek and West Fisher Creek drainages. Many of the other reasonably foreseeable actions would use the same roads as the Montanore Project. The reasonably foreseeable actions and the Montanore Project would cumulatively increase traffic volumes near access roads. The additional traffic would not adversely affect the level of service on U.S. 2 or lead to adverse congestion. The Libby Port Authority will construct a new approach road to the Kootenai Business Park. The approach would be designed not to affect the transportation system level of service or safety in the analysis area.

3.20.4.4 Regulatory/Forest Plan Consistency

All action alternatives would be consistent with the KFP standards regarding roads, regulations governing the administration of the Forest Transportation System (36 CFR 212), and with the Forest Service Transportation Administrative Policy FSM Chapter 7700 (2001). All roads to be built for the project would be constructed, maintained, and decommissioned to minimize adverse environmental impact. Only the minimum number of roads would be constructed to the minimum standard necessary. Unneeded roads used during construction would be decommissioned. KNF Compliance with INFS standards applicable to roads have been discussed in section 3.6, *Aquatic Life and Fisheries.*

3.20.4.5 Irreversible and Irretrievable Commitments

All mine alternatives would increase traffic on the roadways, thereby increasing the fuel used by vehicles beyond the no-mine alternative. Fuel is a non-renewable resource; thus, an increase in traffic related to the mine alternative would result in an irreversible commitment of resources. All mine alternatives would increase the number of accidents during the mine's operation and closure. Increased accidents would be an irreversible commitment of resources.

3.20.4.6 Short-term Uses and Long-term Productivity

During the mine's and transmission line construction, operation and closure, increased traffic congestion and accidents could occur on roads and highways used in the project, and would cease at the end of the closure period.

3.20.4.7 Unavoidable Adverse Environmental Effects

During the mine's operation and closure, traffic congestion and accidents would occur on roads and highways used in the project. Increased congestion and accidents would cease at the end of the closure period.

3.21 Vegetation

The section describes the effects on four separate resources: vegetation communities; old growth ecosystems; threatened, endangered, and sensitive; and noxious weeds. Scientific names of plants are provided in the Vegetation Update Report (Westech 2005d). Section 3.22, *Wetlands and Other Waters of the U.S.* discusses effects on wetland plant communities.

3.21.1 Vegetation Communities

3.21.1.1 Regulatory Framework

The National Forest Management Act (NFMA) prescribes specific management goals on National Forest System lands. The primary objective of the NFMA is to establish land and resource management planning guidelines, goals, and objectives to achieve effective and balanced uses while protecting renewable resources on National Forest System lands. Under NFMA, Forest Plans shall "provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." (16 USC 1604(g)(3)(B)).

In addition to the NFMA, the KNF vegetation management practices are developed according to guidelines and goals established in the KFP. Riparian areas within the KNF are managed according to RMOs established in the INFS. The RMOs and RHCAs have been discussed in section 3.6, *Aquatic Life and Fisheries.*

For lands affected by the transmission line, the MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives.

3.21.1.2 Analysis Area and Methods

The analysis area consists of all areas that would be disturbed by facility construction under any alternative (Figure 83). The vegetation at the Libby Loadout has been completely disturbed and the loadout is not discussed further. Vegetation mapping for the analysis area was obtained from baseline inventories (Western Resource Development 1989d, 1989e; Westech 2005d, Geomatrix 2007e; Hydrometrics Inc. in MMI 2005a). Vegetation community mapping for previously harvested coniferous forest was obtained directly from the KNF harvest GIS data layer. In calculations for effect, previously harvested coniferous forest took precedence over wetland/riparian mapping when areas overlapped. All areas that were determined not to be previously harvested coniferous forest or wetland/riparian were mapped as coniferous forest vegetation community.

Impacts of the mine alternatives on vegetation communities were determined by calculating the number of acres that would be disturbed. The mine reclamation plans of the alternatives also were compared. The analysis of transmission line effects calculated the total acreage within the clearing width of each alternative. Actual acreage cleared would be less and would depend on tree height, slope, and line clearance above the ground. Vegetation communities affected by road construction for transmission line access were calculated for each alternative. For analysis

purposes, it is assumed that minor disturbances of vegetation from staging and yarding areas and stringing, and tensioning sites would occur within the clearing width.

3.21.1.3 Affected Environment

Vegetation communities have developed across the landscape in response to climate, disturbance, and other environmental factors. Historically, dominant forest species were long-lived species such as white pine, western larch, ponderosa pine, and whitebark pine. Currently, the forest stands in the analysis area are dominated by short-lived seral species such as Douglas-fir, lodgepole pine, grand fir, and western hemlock. Changes in composition are due primarily to past management activities such as timber harvesting and fire suppression (USDA Forest Service 2001). Three dominant vegetation communities—coniferous forest; previously harvested coniferous forest; and wetlands including riparian areas—are documented in the analysis area; a total of 410 species were observed (Westech 2005d). Vegetation communities observed and documented in the analysis area are shown in Figure 83 and summarized below.

3.21.1.3.1 Coniferous Forest

About 50 percent of the analysis area is composed of coniferous forest vegetation communities including unlogged areas. Coniferous forests have large economic potential associated with timber harvesting and provide habitat for a variety of wildlife and plant species. Timber harvesting occurs mainly where the dominant tree species are western hemlock, western red cedar, grand fir, Engelmann spruce, Douglas-fir, lodgepole pine, and western larch (Westech 2005d).

Stand structure within the KNF varies from new growth to old growth managed areas. Within the coniferous forest vegetation communities, the KNF has identified stands of old growth that are managed to maintain diversity and habitat for wildlife and plant species. Old growth ecosystems and the habitat they provide for wildlife species are described in section 3.21.2, *Old Growth Ecosystems*.

The KNF has established Vegetative Response Units (VRUs) to aggregate lands having similar management potential and to assist the KNF in preparation of site-specific prescriptions. The VRU system can help interpret vegetation community response to natural disturbance and project future landscapes based on current conditions. The major VRUs in the analysis area are VRU5S and VRU5N, which are moderately cool and moist ecosystems (USDA Forest Service 1999b).

3.21.1.3.2 Previously Harvested Coniferous Forest

The previously harvested coniferous forest vegetation community includes all areas where trees have been harvested and/or clear cut. Most previously harvested areas have well-established conifer regeneration with western larch, western white pine, grand fir, and lodgepole pine. Higher-elevation areas are dominated by Engelmann spruce and subalpine fir, while lower-elevation areas are dominated by Douglas-fir, lodgepole pine, and ponderosa pine. As with the coniferous forest vegetation type, understory composition and cover varies considerably with site conditions, elevation, tree cover, and stand age. In younger previously harvested coniferous forest areas, more introduced species and noxious weeds are present than in older harvested areas (Westech 2005d).

3.21.1.3.3 Wetlands and Riparian Areas

Within the analysis area, wetlands and riparian vegetation communities are present along most streams and rivers. Wetlands are also found in depressions at both tailings impoundment sites, and along the transmission line alternatives. Wetlands and wetland vegetation are discussed in section 3.22, *Wetlands and Other Waters of the U.S.*

Riparian areas along Fisher River, Libby Creek, and Miller Creek support several riparian/wetland vegetation communities including riparian coniferous forest, cottonwood forest, shrub thickets, and herbaceous fringes. Riparian coniferous forest includes western red cedar, western hemlock, and Engelmann spruce with understory species of ladyfern, devil's club, oakfern, common horsetail, and Rocky Mountain maple. Riparian cottonwood forests are present along Fisher River, where black cottonwood and ponderosa pine are the dominant tree species with common snowberry, alder buckthorn, and Wood's rose making up the understory. Other herbaceous species include introduced reed canarygrass, native fowl bluegrass, and introduced common tansy, a noxious weed. Shrub thickets are present along the Fisher River, Miller Creek, and upper elevation streams with stands of Douglas spirea, thinleaf or Sitka alder, and alder buckthorn.

3.21.1.3.4 Other Vegetation Communities

Other vegetation communities in the analysis area are present in small quantities (Westech 2005d). Mapping of these vegetation communities has been consolidated with more dominant vegetation communities in the analysis area. These small vegetation communities are described below.

The shrub-field vegetation community is found in avalanche chutes where rock outcrops, talus, or scree are present. The shrub-fields are periodically destroyed by avalanche and have low cover and low tree density. Shrub species include Rocky Mountain maple, common snowberry, white spirea, pachistima, serviceberry, and bristly Nootka rose. For analysis purposes, the shrub-field vegetation community was included in the coniferous forest community.

The grassland community is found on steep convex ridges or slopes. Dominant grass species are natives including Idaho fescue, purple reedgrass, and elk sedge. Other common herbaceous species are clubmoss, fescue sandwort, yellow buckwheat, Sandberg's lomatium, Alberta penstemon, and western groundsel. For analysis purposes, the grassland community was included in the previously harvested coniferous forest community.

The Libby Adit Site, which is private land, was revegetated, reclaimed, and subsequently has been redisturbed by MMC. The disturbed mining area is dominated by introduced forbs such as birdsfoot trefoil and Dutch clover. Grasses such as introduced red fescue and native big bluegrass also are present. Some native forbs and noxious weeds such as spotted knapweed have established as well as some tree species. For analysis purposes, the area disturbed at the Libby Adit Site was included in the previously harvested coniferous forest community.

3.21.1.3.5 Agricultural Land

Agricultural land used for livestock grazing is located along the Fisher River and along the Bear Creek Access Road. Dominant species include introduced timothy, Kentucky bluegrass, orchard grass, white Dutch clover, and red clover. For purposes of analysis, agricultural land areas were combined with previously harvested coniferous forest community.

3.21.1.4 Environmental Consequences

3.21.1.4.1 Alternative 1 – No Mine

The No Mine Alternative would not remove or affect any vegetation communities or individual species. Monitoring wells installed as part of the baseline monitoring would be removed and the area reclaimed. Disturbances on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals. Introduced species would continue to increase from current disturbance areas.

3.21.1.4.2 Alternative 2 – MMC's Proposed Mine

Alternative 2 would result in the removal and loss of vegetation communities on up to 2,581 acres during mine operations (Table 141). The coniferous forests vegetation community would be most affected, with up to 1,560 acres disturbed. The coniferous forest vegetation communities include old growth stands, which are discussed in section 3.21.2, *Old Growth Ecosystems*. Previously harvested coniferous forest would be the second largest vegetation community impacted, with a disturbance of 949 acres. About 72 acres of riparian and wetland areas would be affected by Alternative 2. Alternative 2 would affect more coniferous forest communities and riparian areas than the other alternatives. Effects on other vegetation communities would be minor.

Table 141. Vegetation Communities within Mine Alternative Disturbance Areas.

Vegetation Community	Alternative 2 MMC's Proposed Mine	Alternative 3 Agency Mitigated Poorman Impoundment Alternative	Alternative 4 Agency Mitigated Little Cherry Creek Impoundment Alternative
Coniferous Forest	1,560	971	1,094
Previously Harvested Coniferous Forest	949	1,035	1,102
Wetland/Riparian Areas	72	5	58
Total	2,582	2,011	2,254

All units are acres.
Source: GIS analysis by ERO Resources Corp. using vegetation mapping in Westech 2005d.

Areas in Alternative 2 that require vegetation clearing and removal would be subject to an overall loss of biodiversity and a change in species composition during mine operations. Reclamation would re-establish plant communities but the biodiversity would be less, introduced species would be more common, species composition would not be the same, and timber production would be lost until the seral forest re-established after several decades. Westech (2005d) documented 410 different plant species in the analysis area. After reclamation of mine disturbances, a forest can take many years to re-establish a community with a diversity of plants similar to but less than the original plant community. Competitive introduced species would limit the ability of native grasses and especially forbs to re-establish after the disturbance. This is an unavoidable impact of allowing the mine disturbance. Vegetation communities designated as previously harvested coniferous forest or areas proposed for merchantable timber sales would have a loss of productivity throughout mining and the KNF would have an overall net loss in timber sales until timber regenerated.

The LAD Areas would experience a change in species composition during water application and may again after water application was discontinued. If not managed properly, the LAD Areas may become dominated by species that favor seasonally saturated conditions, especially introduced species.

Interim reclamation would be used to revegetate disturbances from activities such as road cut and fill slopes and other temporary disturbances. In these locations, vegetation cover would return more quickly than those disturbed by mine operations. Some of the species in the interim mixture are introduced species. Upon completion of mining, disturbed areas would be reclaimed and revegetated. MMC's reclamation goal is to establish a post-mining environment comparable with existing conditions. The reclamation plan includes areas designated for reforestation, shrubs, or grasslands.

The permanent seed mix for Alternative 2 would be dominated by native species but more aggressive non-native species are included in the seed mix. In MMC's monitoring plan, three consecutive years of revegetation success would be achieved before bond release would be requested. Loss of native species and an increase in introduced species is an unavoidable impact of allowing the mine disturbance.

3.21.1.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would disturb up to 2,011 acres of vegetation (Table 141). The largest effect would be to the previously harvested coniferous forest vegetation communities (1,035 acres) and coniferous forest vegetation communities (971 acres). Timber would only be cleared in portions of the proposed LAD Area 2 if an additional water disposal area were needed. The impact to riparian and wetland areas would be about 5 acres and effects on other vegetation communities would be a small percentage of the disturbance. Effects on vegetation communities would be about 571 acres less than Alternative 2 because of a smaller Poorman Tailings Impoundment. The loss of biodiversity, increase in introduced species, change in species composition, and loss of timber production on disturbed lands until forest regeneration would be similar to that described for Alternative 2.

3.21.1.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would disturb up to 2,248 acres of vegetation, including 1,094 acres of coniferous forests and 1,102 acres of previously harvested coniferous forest (Table 141). The impact to riparian and wetland areas would be about 58 acres. Effects on loss of biodiversity, increase in introduced species, change in species composition, and timber production on disturbed lands would be similar to Alternative 2.

3.21.1.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.21.1.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the least effect on vegetation communities compared to the other transmission line alternatives because of a narrower clearing width (150 feet compared to 200 feet). The coniferous forest vegetation communities would be most affected by Alternative B. About 139.5 acres of coniferous forests, 145.5 acres of previously harvested coniferous forest, and 12.3 acres of wetland and riparian areas could be cleared (Table 142). Actual clearing would likely be less than that shown in Table 142 depending on tree height, slope, and line distance above the ground. Construction of new access roads for transmission line installation and maintenance are estimated to affect about 9.7 acres of coniferous forest, 4.5 acres of previously harvested coniferous forest, and about 0.1 acre of wetland and riparian areas.

All disturbed areas would be interim seeded with grass and shrub species when construction of the transmission line and loop line was completed. Areas where trees would be trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. In accordance with BPA's health and safety policy, vegetation would be prevented from growing in the Sedlak Park Substation or within 5 feet of the substation fence. Within and outside the 100-foot right of way and within the 300-foot clearing width of the substation loop line, trees that pose a risk of falling on the transmission line would be cleared over the life of the line. Roads opened or constructed for transmission line access would be closed after transmission line construction was completed. The road surface would be reseeded as an interim reclamation measure designed to stabilize the surface. Where soil was salvaged from new roads, the road surface would be covered with soil and then reseeded. The new road prism would remain during transmission line operations. Introduced species would increase during mine life from the disturbance as well as from introduced species in the interim seed mix.

The BPA would clear all trees from its proposed 2-acre Sedlak Park Substation, including the access road between U.S. 2 and the substation. It also would clear the woody vegetation within the 300-foot-wide right-of-way for the loop line that would connect the substation to the Noxon-Libby Transmission Line, in order to construct, operate, and maintain the substation and loop line. Following the completion of mining activities, the BPA would dismantle the substation, remove the loop line, and revegetate the area assuming it had no need for these facilities.

During the final reclamation phase following mining, the transmission line would be removed, roads recontoured to match existing topography, trees along the line allowed to grow, and all disturbed areas revegetated. Grassland and shrub communities would be the quickest to establish; the coniferous forest community and riparian forest would take many years to establish because many species are relatively slow growing.

Effects on loss of biodiversity, increase in introduced species, change in species composition, and timber production on disturbed lands would be similar but less than mine Alternatives 2, 3, and 4. These are unavoidable impacts of allowing the transmission line construction.

3.21.1.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

The use of a 200-foot clearing width for wooden H-frame structures for Alternative C would result in greater vegetation disturbance than Alternative B. About 166.7 acres of coniferous forest, 153.7 acres of previously harvested coniferous forest, and 4.6 acres of wetland/riparian areas would be cleared and would remain cleared over the life of the transmission line (Table 142). In Alternatives C, D, and E, a Vegetation Clearing Plan would be developed to minimize vegetation

clearing in sensitive areas, such as RHCAs. Use of a helicopter to clear timber and construct structures in areas near core grizzly bear habitat would minimize effects on vegetation communities in these areas. Road construction would affect about 2.3 acres of vegetation including about 1.3 acres of coniferous forests, and 0.9 acre of previously harvested coniferous forest and 0.1 acre of wetlands. New roads on National Forest System lands would be placed into intermittent stored service by using a variety of treatment methods after transmission line construction was completed. Trees would be planted in all areas where trees were removed for the construction of the transmission line including access roads and other disturbances such as line stringing and tensioning sites, slash burn piles, and construction pads. Trees would be planted at a density such that at the end of 5 years the approximate stand density of the adjacent forest would be attained at maturity. This standard would not apply to roads placed in intermittent stored status, but would apply when the roads would be decommissioned after the transmission line was restored. Planting trees in disturbances would require less time for trees to become establish, would better match surrounding landscape features, and would meet wildlife and density recommendations provided by the agencies.

Effects on loss of biodiversity, increase in introduced species, change in species composition, and timber production on disturbed lands would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B and C. These are unavoidable impacts of allowing the transmission line construction.

3.21.1.4.8 Alternative D – Miller Creek Transmission Line Alternative

Alternative D, with a clearing width of 200 feet would affect up to about 179.8 acres of coniferous forest and 148.6 acres of previously harvested coniferous forest, and about 14.0 acres of wetland/riparian areas (Table 142). Road construction would affect about 1.9 acres of vegetation including 1.2 acres of coniferous forest, 0.1 acre of wetlands and riparian areas, and 0.6 acre of previously harvested coniferous forest. Reclamation and transmission line decommissioning at the end of mining operations would be the same as Alternative C.

Effects on loss of biodiversity, increase in introduced species, change in species composition, and timber production on disturbed lands would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B, C, and D. These are unavoidable impacts of allowing the transmission line construction.

3.21.1.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

Alternative E includes tree clearing widths of 150 to 200 feet, depending on location. Clearing could affect about 118.1 acres of coniferous forest and 28.6 acres of wetland/riparian vegetation over the life of the transmission line. This alternative would make the best use of existing timber harvest areas (207 acres) to reduce the amount of new tree clearing. Road construction would disturb about 1.7 acres of coniferous forest and 1.7 acres of previously harvested coniferous forest. Reclamation at the end mining operations would be similar to Alternatives B, C, and D.

Effects on loss of biodiversity, increase in introduced species, change in species composition, and timber production on disturbed lands would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B, C, and D. These are unavoidable impacts of allowing the transmission line construction.

Table 142. Vegetation Communities along Transmission Line Alternatives.

Type†	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Transmission Line Clearing Area				
Coniferous Forest	139.5	166.7	179.8	118.1
Previously Harvested Coniferous Forest	145.5	153.7	148.6	207.3
Wetland/Riparian	12.3	4.6	14.0	28.6
Subtotal	297.3	325.0	342.4	354.0
Areas Disturbed by New or Upgraded Roads				
Coniferous Forest	9.7	1.3	1.2	1.7
Previously Harvested Coniferous Forest	4.5	0.9	0.6	1.7
Wetland/Riparian	0.1	0.1	0.1	0.1
Subtotal	14.3	2.3	1.9	3.5
Sedlak Park Substation and Loop Line				
Coniferous Forest	0.5	0.5	0.5	0.5
Previously Harvested Coniferous Forest	3.9	3.9	3.9	3.9
Subtotal	4.4	4.4	4.4	4.4
Total	316.0	331.7	348.7	361.9

All units are acres, rounded to the nearest 0.1 acre.

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.

Source: GIS analysis by ERO Resources Corp. using KNF data, and vegetation mapping in Westech 2005d and MMI 2005b.

3.21.1.4.10 Cumulative Effects

Past actions, particularly timber harvest, road construction, wildfires, and fire suppression activities, have altered the vegetation communities in the analysis area. Vegetation cover and diversity in disturbed areas has decreased. Disturbances have increased the distribution of noxious weeds and other introduced species. In the areas surrounding the proposed Montanore Project, several projects would contribute to the cumulative effect on vegetation communities such as the Libby Creek Ventures Drilling Plan and the Miller-West Fisher Vegetation Management Project. These projects would result in various degrees of vegetation clearing, disturbance, and subsequent revegetation. The primary effects would include an incremental change in species composition from converting forests to an early successional stage or to grasslands and shrubland. These changes would cumulatively affect species biodiversity and productivity in the region.

3.21.1.4.11 Regulatory/Forest Plan Consistency

All alternatives would be in compliance with the KFP regarding vegetation communities. Under the proposed KFP amendment that would be implemented with each action alternative, the operating permit areas for the mine facilities and much of the transmission line corridors would be reallocated to non-timber production use. This change would be consistent with the KFP where management prescriptions are designed to preserve diversity for desirable plant species. Reclaimed plant communities would eventually re-establish diverse plant communities but the overall vegetation diversity would be less than the original plant communities and introduced species would increase. Compliance with the INFS and RHCA standards and guidelines have been discussed in section 3.6, *Aquatic Life and Fisheries*. Compliance with standards for old growth is discussed in section 3.21.2, *Old Growth Ecosystems*.

3.21.1.4.12 Irreversible and Irretrievable Commitments

All of the mine alternative and transmission line alternatives would disturb vegetation communities, most of which would be subsequently mitigated by revegetation. Revegetated areas would eventually return to predisturbance productivity, but vegetation diversity would be lower than existing conditions. Decreased production of timber during mine operations and for several decades after reclamation would be an irretrievable commitment of resources. The tailings impoundment areas, which would disturb about 600 acres in each mine alternative, would be managed for mineral development following operations, and would no longer be managed for timber production. The area covered by asphalt and gravel by widening the Bear Creek Road would not be returned to pre-mine uses. These effects would be an irretrievable commitment of resources. The loss of native plant species and increase in introduced species in all mine and transmission line alternatives would be an irreversible resource commitment.

3.21.1.4.13 Short-term Uses and Long-term Productivity

Mining operations and transmission line construction, operation, and decommissioning for all action alternatives would result in long-term impacts to vegetation communities and productivity. Productivity for forested areas would remain low following reclamation until new timber stands are established. A long-term loss of vegetation diversity from loss of native species would occur for each of the mine alternatives. Production of introduced species would increase on the disturbed areas.

3.21.1.4.14 Unavoidable Adverse Environmental Effects

An unavoidable loss of and change in vegetation during mining operations would occur. Reclamation of disturbed areas following mining would reclaim most areas to pre-mining vegetation conditions over the long term; communities would be altered and not all native species would re-establish. Introduced species would increase. This loss of some native species and increase in introduced species would be unavoidable impacts.

3.21.2 Old Growth Ecosystems

This section describes vegetative characteristics of old growth forests and features particularly important to wildlife. Old growth habitat is recognized for its unique ecological characteristics that serve as important habitat for both wildlife and some species of rare plants on the KNF. According to the KFP, 58 wildlife species use breeding and/or feeding habitat in old growth forest. While these species may not solely depend on old growth, they require old growth structure for part of their life cycle. Five species (barred owl, great gray owl, pileated

woodpecker, boreal red-backed vole, and brown creeper) have a strong preference or possible dependence on old growth.

The KFP identified the pileated woodpecker as the management indicator species for old growth forest habitat and all associated wildlife species (KFP, Appendix 12). For effects to old growth-associated wildlife species, refer to the pileated woodpecker analysis in section 3.24, *Wildlife Resources*. Forest sensitive species and State Species of Concern associated with old growth (flammulated owl, fisher, and northern goshawk) are also discussed in section 3.24, *Wildlife Resources*.

3.21.2.1 Regulatory Framework

The KFP establishes forest-wide goals, objectives, standards, guidelines, and monitoring requirements for old growth. According to KFP guidelines, "old growth should be recognized as an important habitat and managed to ensure its availability and utility to wildlife over time" (USDA Forest Service 1987). The following standards for old growth are in the KFP:

- To maintain a minimum of 10 percent of the KNF land base below 5,500 feet in elevation in old-growth timber condition
- To maintain an even distribution of old growth habitat through most major drainages, representing the major forest types in each drainage

KNF Supplement No. 85 to FSM 2432.22 direction is to ensure that a minimum of 10 percent old growth is designated for each 3rd-order drainage or compartment (or a combination thereof) before approving timber harvest (USDA Forest Service 1991).

A goal outlined in the KFP is to "Maintain diverse age classes…including old growth timber in sufficient quality and quantity to maintain viable populations of old growth dependent species and to maintain habitat diversity representative of existing conditions" (USDA Forest Service 1987). KFP direction specifies that old growth designated as MA 13 will "be managed to retain their old growth characteristics." MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. Additional direction provided by Castaneda (2004) specifies that "harvest treatments in Forest Plan designated old growth stands (MA 13) will require a Forest Plan amendment."

The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives.

3.21.2.2 Analysis Area and Methods

The analysis area for evaluating direct and indirect impacts of the project on old growth in the KNF includes the Crazy and Silverfish Planning Subunits (PSUs), which are planning areas generally based on watersheds that encompass project facilities for all alternatives (Figure 84). The analysis area for evaluating direct and indirect impacts of the transmission line on old growth on private and state land consists of all non-National Forest System lands that would be disturbed by any of the alternative transmission line routes (Figure 84). The KNF and any non-National Forest System lands potentially disturbed by the alternative transmission line routes is the analysis area for cumulative effects to old growth.

Impacts of the mine alternatives on old growth were based on the area that would be disturbed by the mine features and associated roads. Transmission line impacts were based on the clearing width and new and improved roads associated with each alternative. Actual acreage cleared would be less and would depend on tree height, slope, and line clearance above the ground.

Management and characteristics of old growth are discussed and summarized in the KFP (Appendix 17, KFP II-1, 7, 22, KFP III-54), Green *et al.* (1992, errata corrected 2005), Pfister *et al.* (2000), Kootenai Supplement No. 85 to FSM 2432.22 (USDA Forest Service 1991), and Castaneda (2004), all of which are incorporated by reference. The KFP provides a description of old growth by habitat group (warm-dry, cool-moist, warm-moist). Since the release of the KFP, new information on old growth has become available. Pfister *et al.* (2000) conducted a peer review of documents that provide old-growth descriptions and attributes, and concluded that Green *et al.* (1992, errata corrected 2005) provides the best available source for identifying old growth. As a result, the KNF currently uses Green *et al.* (1992, errata corrected 2005) as the primary tool for identifying potential old growth stands.

Old growth stands on National Forest System lands were identified based on data from Ranger District files and surveys and the KNF old growth GIS layer. As specified in the KNF Supplement No. 85 to FSM 2432.22, old growth stands were field verified for the Crazy and Silverfish PSUs. Changes in old growth mapping resulting from recent field verification have not been incorporated into this Draft EIS. All old growth stands that have been field verified will be mapped and incorporated into impact calculations in the Final EIS. Field verification of old growth stands was completed using both walk-through and common stand exam methods, as described in the Vegetation Update Report (Westech 2005d). Stands above 5,500 feet are not suitable for reproduction of most old growth associated wildlife species (USDA Forest Service 1987), and are not included as part of the old growth MAs or calculations of old growth on the KNF.

Impacts of the alternatives on old growth on National Forest System lands were evaluated according to the following criteria:

- Acres of vertical structure removed in designated old growth. This is the area cleared of designated old growth, including both designated effective and designated replacement old growth
- Acres of vertical structure removed in undesignated effective old growth
- Road length built adjacent to or through designated old growth (in feet)
- Acres affected by edge in old growth
- Acres of interior habitat remaining in old growth
- Acres of old growth designated
- Percent of designated old growth remaining in the PSU

Effective old growth stands support the habitat conditions described in Green *et al.* (1992, errata corrected 2005). Replacement old growth stands do not have enough old growth characteristics to be considered old growth, but are expected to become old growth in time. Designated old growth consists of stands that have been given a specific MA designation, such as MA 13, as identified in the KFP. Effective old growth stands may have been identified after the KFP was published, and some have not been assigned to an old growth management area.

Research has indicated that certain activities, in particular regeneration harvest, within or adjacent to old growth stands may influence vegetative characteristics and wildlife use of those stands (Harris 1984; Ripple *et al.* 1991; Morrison *et al.* 1992; Province of BC 1995; Russell *et al.* 2000; Russell and Jones 2001). Although the width of old growth shown to be influenced by edge varies depending on the study (Chen *et al.* 1995), research supports a three-tree height rule of thumb as the distance to which effects occur (Harris 1984; Ripple *et al.* 1991; Morrison *et al.* 1992; Province of BC 1995; Russell *et al.* 2000). On the KNF, the average old growth tree height is 100 feet, based on the KNF Timber Stand Management Record System (TSMRS) database. Existing edge effects were estimated by applying a 300-foot buffer to harvested forest habitat (TSMRS activity codes 4100-4134) less than 30 years old and bordering old growth stands. Effects of alternatives were estimated by applying the same buffer to any resulting old growth edge. Old growth areas not affected by edge effects provide interior habitat.

Old growth mapping for private and state lands along the transmission line was based on photo-interpretation of 2006 aerial imagery and field verification conducted by a Forest Service biologist in 2008. Private land in the Little Cherry Creek impoundment disturbance area has been mostly harvested and was not surveyed for old growth. Impacts to old growth on private lands were evaluated based on the extent of mapped old growth affected.

3.21.2.3 Affected Environment

Old growth forest consists of mature and overmature stands that provide habitat for many wildlife species. The KFP Appendix 17, A17-2, classifies old growth as a "distinct successional stage" having specific characteristics. It defines the "classic" old growth stand as one that is physically imposing with tall, full-crowned trees; large standing dead material; fallen dead material; a dense canopy; and having moderated temperatures. According to Green *et al.* (1992, errata corrected 2005) old growth "…encompasses the later stages of stand development that typically differ from earlier stages in characteristics such as tree age, tree size, number of large trees per acre, and basal area. In addition, attributes such as decadence, dead trees, the number of canopy layers and canopy gaps are important but more difficult to describe because of high variability."

3.21.2.3.1 Existing Old Growth Stands

Existing conditions of old growth forest in the KNF portion of the analysis area are a result of historical timber harvest and wildfires (USDA Forest Service 2003b). Old growth stands occupying mesic sites in the analysis area are dominated by western hemlock and western redcedar. Common subdominant conifers at these sites include grand fir, Englemann spruce, Douglas-fir, and western larch. While western white pine is present at these sites, the majority occur as dead snags, having succumbed to disease. Lower elevation old growth stands are mainly composed of Douglas-fir, ponderosa pine, western larch, grand fir, or lodgepole pine. Upper elevation old growth sites support subalpine fir, western hemlock, western redcedar, grand fir, and Englemann spruce (Westech 2005d). Old growth forests in the Crazy and Silverfish PSUs are shown on Figure 84.

Old growth management area designations in the PSU were made to conserve the best old growth attributes available and to provide the best distribution, size, habitat type coverage, and quality possible. These old growth stands are physically connected to other old growth stands where possible, or are interconnected to adjacent old growth stands by stands composed of age classes more than 100 years old.

Table 143 summarizes the amount of old growth below 5,500 feet in elevation in the Crazy and Silverfish PSUs and the KNF. Table 143 also shows the amount of effective old growth, replacement old growth, effective or replacement old growth that has been given an MA designation or remains undesignated, and designated old growth required to meet KFP standards.

The Crazy PSU contains 55,925 total acres below 5,500 feet, including 47,982 acres of National Forest System lands, 6,702 acres of private lands, and 1,241 acres of state lands. Old growth stands on private and state lands have been mostly harvested, and the 9,097 acres of old growth (all categories) remaining on National Forest System lands below 5,500 feet is about 16 percent of all lands, and 19 percent of National Forest System lands below 5,500 feet in the Crazy PSU.

The Silverfish PSU contains 60,839 total acres below 5,500 feet, including 52,078 acres of National Forest System lands, 8,146 acres of private lands, and 615 acres of state lands. Old growth stands on private and state lands have been mostly harvested, and the 6,632 acres of old growth (all categories) remaining on National Forest System lands below 5,500 feet is about 11 percent of all lands, and 12.7 percent of National Forest System lands below 5,500 feet in the Silverfish PSU.

Currently, total designated effective old growth and replacement old growth occupies 16.8 and 12.9 percent of National Forest System lands below 5,500 feet in the Crazy and Silverfish PSUs, respectively (Table 143). Old growth in both PSUs currently meet KNF standards for maintaining at least 10 percent of the land base in old growth (per FSM 2432.22).

3.21.2.3.2 Attributes of Old Growth within the Landscape

As elements of dynamic landscapes, other attributes of old growth stands such as the size of old growth blocks, their juxtaposition and connectivity with other old growth stands, their topographic position, their shapes, their edge, and their stand structure compared to neighboring stands are important to evaluate. To maintain healthy and diverse ecosystems, the full range of natural variation should be represented and landscape mosaics should be managed as a whole (Green *et al.* 1992, errata corrected 2005). Management activities, such as timber harvest, road construction, or mining, have the potential to impact the function of old growth habitat or specific components of old growth, such as quantity of interior habitat, habitat patch sizes, and vertical structure.

Larger blocks (more than 50 acres) of old growth forest provide interior habitat and connectivity within National Forest System lands. Based on recommendations in Morrison *et al.* (1992), stands smaller than 50 acres were designated to protect additional attributes unique to old growth. Smaller patches of older, forested vegetation may be important stepping stones for dispersal of old growth-dependent wildlife species, especially in heavily fragmented landscapes. Although these patches may not meet criteria for interior conditions, their removal could prevent dispersal of some species across a larger landscape (Morrison *et al.* 1992). In the KNF, small patches of old growth habitat are largely surrounded by multi-aged stands, which also provide corridor links to larger blocks of old growth. Old growth block sizes in the Crazy and Silverfish PSUs are shown in Table 144.

Table 143. Old Growth Status in the KNF and the Crazy and Silverfish PSUs.

Old Growth Status	Crazy PSU Acres[1] (Percent[2])	Silverfish PSU Acres[1] (Percent[2])	KNF Acres[3] (Percent[2])
Total National Forest System lands	60,215	60,515	
Total National Forest System lands below 5,500 feet elevation	47,982	52,078	1,869,209
KFP minimum standard for old growth	4,798 (10.0)	5,208 (10.0)	186,921 (10.0)
Designated old growth[4]			
Designated effective[5] old growth	7,801 (16.3)	5,296 (10.2)	136,157 (7.3)
Designated replacement[6] old growth	265 (0.6)	1,361 (2.6)	61,272 (3.3)
Designated unknown[7] (KFP)	0 (0)	63 (<1.0)	19,824 (1.1)
Total designated effective old growth and replacement old growth	8,066 (16.8)	6,720 (12.9)	217,253 (11.6)
Undesignated effective old growth and replacement old growth			
Undesignated effective old growth	819 (1.7)	0 (0.0)	63,534 (3.4)
Undesignated replacement old growth	212 (0.4)	10 (<1.0)	36,792 (2.0)
Totals for both designated and undesignated old growth and replacement old growth			
Total designated and undesignated effective old growth	8,620 (18.0)[8]	5,271 (10.1)[8]	199,109 (10.7)[8]
Total designated and undesignated replacement old growth	477 (<1.0)	1,361 (2.6)	98,064 (5.2)
All old growth below 5,500 feet	**9,097 (19.0)**	**6,632 (12.7)**	**297,173 (15.9)**

[1] Updated in 2007 for the Crazy PSU and in 2006 for the Silverfish PSU. Replacement old growth stands were designated to provide old growth in the future within the PSU.
[2] Percentage calculated based on total National Forest System lands below 5,500 feet elevation.
[3] Forest-wide acres as of September 2006.
[4] Designated old growth: old growth forest designated as an old growth MA, such as MA 13.
[5] Effective old growth: meets all the age and size class old growth requirements, contains typical old growth habitat components, and is large enough or of appropriate shape to allow species dependent on forest interiors to flourish.
[6] Replacement old growth: stands that do not have enough old growth characteristics to be considered old growth, but that are expected to become old growth in time.
[7] Designation unknown: old growth designated as MA 13 in the KFP that has not been surveyed.
[8] Effective old growth includes acres inventoried on the ground plus 60 percent of old growth determined by photo interpretation, plus 60 percent of designated unknown old growth, based on results of old growth surveys described in the KFP. Thus, total designated and undesignated effective old growth is not directly additive.

Table 144. Old Growth Block Sizes in the Crazy and Silverfish PSUs.

Old Growth Status	Number of Blocks	Size Range (acres)	Number of Blocks Over 50 Acres	Percent Blocks Over 50 Acres
Crazy PSU				
Designated				
Effective	35	10 - 1,773	21	60
Replacement	3	25 - 167	1	33
Total	38	10 - 1,773	22	58
Undesignated				
Effective	11	23 - 84	7	64
Replacement	3	15 - 45	0	0
Total	14	15 - 84	7	50
Total of All Old Growth	**52**	**10 - 1,773**	**29**	**56**
Silverfish PSU				
Designated				
Effective	39	10 - 459	27	69
Replacement	22	13 - 167	12	55
Total	61	10 - 459	39	64
Undesignated				
Effective	0	0	0	0
Replacement	0	0	0	0
Total	0	0	0	0
Total of All Old Growth	**61**	**10 - 459**	**39**	**64**

Source: GIS analysis by ERO Resources Corp. using KNF data.

All old growth in the Crazy PSU, including undesignated and designated effective and replacement old growth, comprises a total of 52 blocks ranging from 10 acres to 1,773 acres. About 56 percent of these blocks are greater than 50 acres. Although there is less old growth in the Silverfish PSU, it contains proportionately more old growth blocks over 50 acres than the Crazy PSU. All old growth in the Silverfish PSU consists of 61 blocks ranging from 10 acres to 459 acres, with about 64 percent of the old growth blocks greater than 50 acres.

3.21.2.3.3 Stand Structure

Old growth stand structure is described by Green *et al.* (1992, errata corrected 2005). In summary, Green identifies three structural stages that are useful in describing old growth: late seral single-story (*e.g.*, ponderosa pine, Douglas-fir, or lodgepole pine sites); late seral multi-story (*e.g.*, larch or western white pine sites); and near-climax (*e.g.*, cedar, grand fir, or subalpine fir sites). Old growth stands in the Crazy and Silverfish PSUs can be characterized as predominately multi-story or near-climax (Westech 2005d).

3.21.2.3.4 Disturbance

Many roads and trails in the Crazy and Silverfish PSUs either bisect or are adjacent to old growth stands. Roads facilitate pedestrian and motorized access to old growth forest habitats, resulting in increased disturbance to vegetation and wildlife. Roads also increase access for firewood cutters who may remove standing snags and down logs that are important components of old growth forests. Within existing designated old growth in the Crazy and Silverfish PSUs, 35 miles of local

roads comprise 10 miles of seasonally restricted roads, 7 miles of roads closed year-round, and 18 miles of roads open year-round.

Timber harvesting can affect adjacent old growth stands by altering six microclimatic factors: solar radiation, soil temperature, soil moisture, air temperature, relative humidity, and wind speed (Chen *et al.* 1995). Microclimatic changes lead to vegetative changes such as species richness, diversity, and composition, and vegetative structure (Russell and Jones 2001). Changes in vegetative conditions may, in turn, affect wildlife, resulting in changes in associated wildlife communities and influencing other factors such as predation and competition (Askins 2000) (see pileated woodpecker analysis in section 3.24, *Wildlife Resources*). Effects of timber harvesting extend varying distances into the uncut stands depending on a number of variables, such as aspect, slope, elevation, wind speed, and direction. The depth of influence is also related to time since harvest, with effects dissipating within 20 to 50 years, depending on the factor (Russell and Jones 2001; Ripple *et al.* 1991; Russell *et al.* 2000). In the Crazy and Silverfish PSUs, average tree growth in stands where regeneration has occurred result in tree heights (20 to 50 feet) and densities (fully stocked stands) that reduce the depth of influence from edge effects after 30 years. Table 145 shows the amount of old growth currently influenced by edge effects, including the number of existing harvested stands (stands less than 30 years old) adjacent to old growth stands. These stands create an edge influence on about 1,790 acres of old growth in the Crazy PSU and about 440 acres of old growth in the Silverfish PSU. While edge areas may result in changes in vegetation and wildlife use, the edge areas remain functional for some species as old growth. Old growth areas not impacted by edge effects provide interior habitat.

3.21.2.3.5 Existing Old Growth Stands on Private and State Lands

The majority of private or state-owned land within the analysis area has been harvested in the past 20 to 30 years (Figure 83) and is heavily roaded. Although most previously harvested areas have well-established conifer regeneration, as described in section 3.21.1, *Vegetation Communities*, these areas do not provide effective old growth habitat. Coniferous forest on private lands is primarily dominated by dry, ponderosa pine/Douglas-fir communities that do not have old growth characteristics. Old growth on private and state lands within the analysis area consists primarily of riparian old growth and occurs mainly in the Fisher River, West Fisher Creek, and Hunter Creek riparian corridors (Figure 84).

3.21.2.4 Environmental Consequences

The following section discusses the direct, indirect, and cumulative effects on old growth for each of the mine alternatives, transmission line alternatives, and combined mine-transmission line alternatives. The mine alternatives would have no effect on old growth in the Silverfish PSU. Impacts of the transmission line alternatives on old growth in the Silverfish PSU would be limited to edge effects to 2 acres of old growth and a loss of 2 acres of interior old growth for Alternative E. Impacts on old growth in the Crazy PSU from the mine and transmission line alternatives are summarized in Table 145 and Table 146.

Table 145. Summary of Impacts on Old Growth from the Mine Alternatives in the Crazy PSU.

Measurement Criteria	[1] No Mine/Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative	[4] Agency Mitigated Little Cherry Creek Impoundment Area
Unmitigated Effects				
Vertical structure removed in designated OG (acres)[1]	0	157	175	25
Remaining designated OG in PSU (OG+ROG)	8,066	7.909	7,891	8,041
Percent of designated OG in PSU (OG+ROG)	16.8	16.5	16.4	16.8
Vertical structure removed in undesignated OG (acres)[2]	0	150	8	150
Total road length in feet adjacent or through designated OG or ROG	163,627 (0)	164,947 (1,320)	164,947 (1,320)	164,947 (1,320)
Number of existing or proposed harvest stands adjacent to OG	76	79	81	81
Edge influence in OG (acres)	1,790	1,915 (+125)	1,957 (+167)	1,917 (+127)
Interior habitat remaining in OG (acres)	5,918	5,475 (-443)	5,562 (-356)	5,609 (-309)
Mitigated Effects				
OG designated to mitigate OG physically lost (acres)[3]	0	0	366	350
OG designated to mitigate edge effects (acres)[4]	0	0	167	127
OG designated to mitigate for designated OG changed to MA 31 (acres)[4]	0	0	54	182
Total OG designated (acres)	0	0	587	659
Percent of designated OG in PSU after mitigation	16.8	16.5	17.7	18.1

(#) Change from existing conditions due to the alternative.
OG = Old growth.
ROG = Replacement Old Growth.
Old growth would not be affected in the Silverfish PSU.
[1] Includes effective and replacement old growth.
[2] Effective old growth only.
[3] Mitigation for physical loss of old growth would be at a 2:1 ratio.
[4] Mitigation for increased edge effects or reallocation of designated old growth (MA 13) to MA 31 (Mineral Development) would be at a 1:1 ratio. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 146. Summary of Impacts on Old Growth from the Transmission Line Alternatives.

Measurement Criteria	Alternative A – No Trans-mission Line/ Existing Conditions	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Crazy PSU					
Unmitigated Effects					
Vertical structure removed in designated OG (acres)[1]	0	23	8	13	13
Remaining designated OG in PSU (OG+ROG) (acres)	8,066	8,043	8,058	8,053	8,053
Percent of designated OG in PSU (effective OG+ROG)	16.8	16.8	16.8	16.8	16.8
Vertical structure removed in undesignated OG (acres)[2]	0	0	0	0	0
Total road length in feet adjacent or through designated OG or ROG	163,627	167,482 (3,854)	163,838 (211)	164,155 (528)	164,155 (528)
Number of existing or proposed harvest stands adjacent to OG	76	80	78	80	81
Edge influence in OG (acres)	1,790	(+102)	(+23)	(+38)	(+38)
Interior habitat remaining in OG (acres)	5,918	(-127)	(-31)	(-52)	(-52)
Silverfish PSU					
Unmitigated Effects[3]					
Edge influence in OG (acres)	0	0	0	0	(+2)
Interior habitat remaining in OG (acres)	0	0	0	0	(-2)
Crazy and Silverfish PSUs					
Mitigated Effects					
OG designated to mitigate OG physically lost (acres)[4]	0	0	16	26	26
OG designated to mitigate edge effects (acres)[5]	0	0	23	38	38
Total OG designated (acres)	0	0	39	64	64
Percent of designated OG in PSU after mitigation	16.8	16.8	16.9	16.9	16.9
Private and State Lands					
Old growth removed (acres)	0	4	2	2	6

(#) Change from existing conditions due to the alternative. OG = old growth; ROG = Replacement Old Growth.
[1] Includes effective and replacement old growth.
[2] Effective old growth only.
[3] None of the transmission line alternatives would remove old growth or increase roads adjacent to old growth in the Silverfish PSU. Impacts to old growth in the Silverfish PSU would be limited to edge effects from Alternative E.
[4] Mitigation for physical loss of old growth would be at a 2:1 ratio.
[5] Mitigation for increased edge effects would be at a 1:1 ratio. Designated old growth (MA 13) within the 500-foot-wide transmission line corridor reallocated as MA 23 would be within the area accounted for by edge effects. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.21.2.4.1 Alternative 1–- No Mine

Alternative 1 would have no direct effect on designated old growth or associated plant and wildlife species (also see pileated woodpecker discussion in section 3.24, *Wildlife Resources*). As shown in Table 145, the conditions for all seven measurement criteria would remain unchanged. All old growth areas would maintain their existing conditions and continue to provide habitat for those species that use the area over a long term. The most recent forest-wide old growth analysis concludes that at least 10 percent of the KNF below 5,500 feet elevation is designated for old growth management (USDA Forest Service 2007d). This alternative would not affect the current proportion of old growth (Table 145) at either the PSU or KNF scale.

3.21.2.4.2 Alternative 2 – MMC's Proposed Mine

Alternative 2 would have the greatest effect on old growth of the mine alternatives, affecting 157 acres of designated old growth and 150 acres of undesignated old growth for a total of 307 acres of old growth habitat affected in the Crazy PSU (Table 145). Old growth in the Silverfish PSU and in private or state land outside the Silverfish PSU would not be affected. Alternative 2 would result in edge effects to about 125 acres of old growth habitat and a loss of about 443 acres of interior old growth habitat. The majority of impacts to designated old growth would occur in the LAD Area 2 at the mouth of Ramsey and Poorman creeks. Trees would be selectively thinned in 200 acres of the LAD Areas where spray irrigation would occur. Although these irrigated areas would likely continue to provide suitable habitat for some old growth-associated species, old growth habitat connectivity could be reduced between the Ramsey Creek and Poorman Creek drainages for other species. All of the impacts to undesignated effective old growth would occur as a result of the Little Cherry Creek Impoundment construction, eliminating 130 acres of a 150-acre old growth block. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, Alternative 2 would result in a 0.3 percent loss of old growth in the Crazy PSU. The percent of designated old growth in the Crazy and Silverfish PSUs would remain above the 10 percent minimum standard specified in the KFP.

Alternative 2 would include the construction of about 1,320 feet of new roads through designated old growth habitat. As a result, less than 1 acre of old growth habitat would be lost. These impacts are included in the impacts to designated and undesignated old growth shown in Table 145. Because new roads would not be open to the public and would be reclaimed at mine closure, they are not likely to reduce snag levels from firewood gathering. Use of new roads associated with mine activities would result in long-term increases in disturbance to vegetation and wildlife.

3.21.2.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would affect 175 acres of designated old growth and 8 acres of undesignated old growth, for a total of 183 acres of old growth habitat in the Crazy PSU. Old growth in the Silverfish PSU and in private or state land outside the Silverfish PSU would not be affected. Relative to other alternatives, Alternative 3 would result in the most edge effects (167 acres) to old growth habitat. Alternative 3 would result in a loss of about 356 acres of interior old growth habitat. The majority of impacts to designated old growth would occur as a result of impoundment construction or in LAD Area 2 at the mouth of Ramsey and Poorman creeks, reducing old growth habitat connectivity between these drainages. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, Alternative 3 would result in a 0.4 percent loss of old growth in the Crazy PSU. The percent of designated old growth in the Crazy and Silverfish PSUs would remain

above the 10 percent minimum standard specified in the KFP. Impacts of new roads constructed for Alternative 3 would be the same as Alternative 2.

Alternative 3 would involve the reallocation of 54 acres of designated old growth (MA 13) to MA 31 (Mineral Development) that have not been accounted for in direct disturbance and indirect edge effects (Table 145). The reallocation of MAs is described in section 3.14, *Land Use*. Although the MA change would not result in disturbance to or physical loss of old growth, the change would reduce the percent of designated old growth in the PSU. The designation of 587 acres of additional old growth would mitigate this reduction (Table 145).

Alternative 3 would include mitigation described in section 2.5.7.3.2, *Key Habitats* for impacts to old growth, such as the designation of additional old growth shown in Table 145 on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. Alternative 3 mitigation would increase the percent of designated old growth in the Crazy PSU to 17.7 percent. Losses and degradation of old growth habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

3.21.2.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would have the least effect on old growth habitat of the mine alternatives, affecting 25 acres of designated old growth and 150 acres of undesignated old growth, for a total of 175 acres of old growth habitat in the Crazy PSU. Old growth in the Silverfish PSU and in private or state land outside the Silverfish PSU would not be affected. At the PSU scale, Alternative 4 would result in a 0.4 percent loss of old growth in the Crazy PSU. Impacts of new roads constructed for Alternative 4 would be the same as those described for Alternative 2.

Similar to Alternative 2, Alternative 4 would result in edge effects to about 127 acres of old growth habitat. Relative to the other mine alternatives, the least amount of interior old growth habitat (309 acres) would be lost as a result of Alternative 4.

Alternative 4 would involve the reallocation of 182 acres of designated old growth (MA 13) to MA 31 (Mineral Development) that have not been accounted for in direct disturbance and indirect edge effects. Although the MA change would not result in disturbance to or physical loss of old growth, the change would reduce the percent of designated old growth in the PSU. The designation of 659 acres (Table 145) of additional old growth would mitigate this reduction.

Mitigation for impacts to old growth for Alternative 4 would be similar to Alternative 3, except that Alternative 4 mitigation would increase the percent of designated old growth in the Crazy PSU to 18.1 percent.

3.21.2.4.5 Alternative A – No Transmission Line

Alternative A would have no direct effect on designated old growth or associated plant and wildlife species (also see discussion in section 3.24.3.5, *Pileated Woodpecker*). The conditions for all seven measurement criteria (Table 146) would remain unchanged. All old growth areas would maintain their existing conditions, and continue to provide habitat for those species that use the area over a long term. The most recent forest-wide old growth analysis concludes that at least 10 percent of the KNF below 5,500 feet elevation is designated for old growth management. This

alternative would not affect the current proportion of old growth (Table 146) at either the PSU or KNF scale.

3.21.2.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the greatest impact on old growth habitat of the transmission line alternatives, affecting 23 acres of designated old growth in the Crazy PSU (Table 146). No undesignated old growth would be affected by Alternative B. Old growth in the Silverfish PSU would not be affected by Alternative B. Alternative B would result in edge effects to about 102 acres of old growth habitat and a loss of about 127 acres of interior old growth habitat. Alternative B would remove about 4 acres of old growth habitat on private land along the Fisher River and a short portion of Miller Creek. Loss of old growth habitat and edge effect may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

The majority of impacts to old growth would occur in the Ramsey Creek corridor and at the confluence of Libby and Howard creeks, reducing old growth habitat connectivity in these drainages. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, the loss of old growth would have negligible effects on the proportion of old growth in the Crazy PSU (Table 146). The percent of designated old growth in the Crazy and Silverfish PSUs would remain above the 10 percent minimum standard specified in the KFP.

Alternative B would include the construction of about 3,854 feet of new roads through designated old growth habitat. As a result, less than 3 acres of old growth habitat would be lost. These impacts are included in the impacts to designated and undesignated old growth shown in Table 146. Because new roads would not be open to the public, would undergo interim reclamation after construction, and would be bladed and recontoured to match existing topography at transmission line decommissioning, the roads are not likely to reduce snag levels from firewood gathering. Use of new roads associated with transmission line construction would result in short-term disturbance to vegetation and wildlife.

3.21.2.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would have the least effect on old growth habitat of the transmission line alternatives, affecting 8 acres of designated old growth habitat in the Crazy PSU (Table 146). No undesignated old growth would be affected by Alternative C. Old growth in the Silverfish PSU would not be affected by Alternative C. Relative to other alternatives, Alternative C would result in the fewest edge effects (23 acres) to old growth habitat. Alternative C would result in a loss of about 51 acres of interior old growth habitat. Alternative C would remove about 2 acres of old growth habitat on private land where the transmission line would cross the Fisher River (Figure 84).

The majority of impacts to old growth would occur at the confluence of Libby and Howard creeks, reducing old growth habitat connectivity between these drainages. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, the loss of old growth would have a negligible effect on the proportion of old growth composition in the Crazy PSU and would not measurably impact old growth characteristics and attributes in the Crazy PSU or the KNF. The percent of designated old

growth in the Crazy and Silverfish PSUs would remain above the 10 percent minimum standard specified in the KFP.

Alternative C would include the construction of about 211 feet of new roads through designated old growth habitat. As a result, less than 0.25 acre of old growth habitat would be lost. These impacts are included in the impacts to designated and undesignated old growth shown in Table 146. Because new roads would not be open to the public and would be placed into intermittent stored service after transmission line construction, they are not likely to reduce snag levels from firewood gathering. Use of new roads associated with transmission line construction would result in short-term increased disturbance to vegetation and wildlife.

Mitigation for impacts of Alternative C on National Forest System lands would include the designation of additional old growth shown in Table 146. Alternative C mitigation would increase the percent of designated old growth in the Crazy PSU to 16.9 percent. Loss of old growth habitat and edge effect may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

Impacts to old growth on non-National Forest System lands would be minimized through implementation of the Environmental Specifications (Appendix D) and Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*). Also, the use of monopoles in these areas, if incorporated into the Vegetation Removal and Disposition Plan, would require less clearing.

3.21.2.4.8 Alternative D – Miller Creek Transmission Line Alternative

Effects on old growth from Alternative D on National Forest System lands would be the same as Alternative C, except that Alternative D would result in slightly more direct impacts and edge effects to old growth. Alternative D would result in the loss of 13 acres of designated old growth habitat, edge effects to 38 acres of old growth habitat, and the loss of about 52 acres of interior old growth habitat in the Crazy PSU (Table 146). Old growth in the Silverfish PSU would not be affected by Alternative C. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species.

Alternative D would include the construction of about 528 feet of new roads through designated old growth habitat. As a result, less than 0.4 acre of old growth habitat would be lost. These impacts are included in the impacts to designated and undesignated old growth shown in Table 146. Because new roads would not be open to the public and would be placed into intermittent stored service after transmission line construction, the roads are not likely to reduce snag levels from firewood gathering. Use of new roads associated with transmission line construction would result in short-term increased disturbance to vegetation and wildlife.

Impacts of Alternative D to old growth on private lands, as well as mitigation of these impacts, would be the same as Alternative C. Mitigation for impacts to old growth from Alternative D on National Forest System lands would be similar to Alternative C, except that slightly more old growth would be designated.

3.21.2.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

Effects on old growth from Alternative E on National Forest System lands would be the same as Alternative D, except that Alternative E would result in edge effects to 2 acres of old growth habitat and a loss of about 2 acres of interior old growth habitat in the Silverfish PSU. Alternative

E would directly impact about 6 acres of old growth habitat on private and state land where the transmission line would cross the Fisher River and parallel West Fisher Creek (Figure 84). Mitigation for these effects would be the same as Alternative C.

3.21.2.4.10 Combined Mine-Transmission Line Effects

Direct impacts of the mine alternatives in combination with the transmission line alternatives are shown in Table 147. Impacts of the combined mine and transmission line alternatives on old growth in the Silverfish PSU would be limited to edge effects to 2 acres of old growth and a loss of 2 acres of interior old growth for Alternatives 3E and 4E. Impacts to old growth from combined mine and transmission line alternatives before mitigation would be the greatest for MMC's proposed alternative (Alternative 2B). Direct impacts to old growth from the agencies' alternatives (Alternatives 3C, 3D, 3E, 4C, 4D, and 4E), including impacts on private and state land, would range from 185 acres to 202 acres. Agency-mitigated alternatives would include mitigation for impacts to old growth, such as the designation of additional old growth shown in Table 147 on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. With mitigation, the agencies' combined alternatives would result in an increased proportion of designated old growth on National Forest System lands. For the agencies' alternatives, impacts to old growth on private land would be minimized through implementation of the Environmental Specifications and Vegetation Removal and Disposition Plan. The use of monopoles in these areas, if incorporated into the Vegetation Removal and Disposition Plan, would require less clearing. For all combined alternatives, losses and degradation of old growth habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

3.21.2.4.11 Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire suppression activities, have altered the old growth ecosystems in the analysis area, resulting in reductions in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; and increases in tree density and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provide access to old growth habitat, contributing to snag removal. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of old growth habitat in the analysis area, but would not affect the proportion of old growth on National Forest System lands. In addition, it is likely that limited amounts of old growth occur on private and state lands, based on past and current harvest practices. The No Action Alternatives (Alternative 1 and Alternative A) would not contribute to cumulative impacts on old growth.

Regeneration harvest included in the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, would not directly affect old growth. The Miller-West Fisher Vegetation Management Project would result in minor increased edge effects where regeneration harvest is proposed adjacent to old growth. Currently, total designated effective old growth and replacement old growth occupies 16.8 and 12.9 percent of National Forest System lands below 5,500 feet in the Crazy and Silverfish PSUs, respectively (Table 143), above the 10 percent minimum standard specified in the KFP. While the action alternatives, in combination with other

Table 147. Summary of Impacts on Old Growth from Combined Mine and Transmission Line Alternatives.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Area		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Unmitigated Effects								
Vertical structure removed in designated OG (acres)[1]	0	175	183	188	188	33	38	38
Remaining designated OG in PSU (OG+ROG) (acres)	8,066	7,891	7,883	8,030	8,030	8,033	8,028	8,028
Percent of designated OG in PSU (OG plus ROG)	16.8	16.4	16.4	16.4	16.4	16.7	16.7	16.7
Vertical structure removed in undesignated OG (acres)[2]	0	150	8	8	8	150	150	150
Total road length (feet) adjacent or through designated OG or ROG	163,627 (0)	168,801 (5,174)	165,158 (1,531)	165,475 (1,848)	165,475 (1,848)	165,158 (1,531)	165,475 (1,848)	165,475 (1,848)
Number of existing or proposed harvest stands adjacent to OG	76	82 (6)	82 (10)	84 (8)	85 (9)	82 (6)	84 (10)	85 (8)
Edge influence in OG (acres)	1,790	(+227)	(+190)	(+205)	(+205)	(+150)	(+165)	(+165)
Interior habitat remaining in OG (acres)	5,918	(-570)	(-387)	(-408)	(-408)	(-340)	(-361)	(-361)
Silverfish PSU								
Unmitigated Effects[3]								
Edge influence in OG (acres)					(+2)			(+2)
Interior habitat remaining in OG (acres)					(-2)			(-2)
Crazy and Silverfish PSUs								
Mitigated Effects								
OG designated to mitigate OG physically lost (acres)[4]	N/A	0	382	392	392	366	376	376
OG designated to mitigate edge effects (acres)[5]	N/A	0	190	205	205	150	165	165
OG designated to mitigate for designated OG changed to MA 31 (acres)[5]	N/A	0	54	54	54	182	182	182
Total OG designated (acres)	N/A	0	626	651	651	698	723	723
Percent of designated OG in PSU (OG plus ROG)	N/A	16.4	17.7	17.7	17.7	18.2	18.2	18.2
Private and State Lands								
Old growth removed (acres)	0	4	2	2	6	2	2	6

(#) number in parentheses is the change due to the alternative. OG = Old growth ROG = Replacement Old Growth; N/A = Not Applicable TL = Transmission Line Alternative.

[1]Includes effective and replacement old growth. Acreage may not equal that shown in Table 145 and Table 146 because of overlapping effects.

[2]Effective old growth only.

[3]None of the transmission line alternatives would remove old growth or increase roads adjacent to old growth in the Silverfish PSU. Impacts to old growth in the Silverfish PSU would be limited to edge effects from Alternative E.

[4]Mitigation for physical loss of old growth would be at a 2:1 ratio.

[5]Mitigation for increased edge effects or reallocation of designated old growth (MA 13) to MA 31 (Mineral Development) would be at a 1:1 ratio.

Source: GIS analysis by ERO Resources Corp. using KNF data.

past, current, and reasonably foreseeable actions, would result in some losses and degradation of old growth habitat, cumulative impacts on levels of old growth would likely be minimal. In addition, mitigation associated with the agencies' Alternatives 3, 4, C, D, and E would increase the proportion of designated old growth and promote the maintenance or development of old growth in the analysis area.

3.21.2.4.12 Regulatory/Forest Plan Consistency

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Designated Old Growth) designation of all harvested stands to either MA 23 (Electric Transmission Corridor) or 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each 3rd-order drainage or compartment, or a combination of compartments.

Analysis of old growth Forest-wide (USDA Forest Service 2007d) concludes that at least 10 percent of the KNF below 5,500 feet is managed as old growth, as required in the KFP. Specifically, National Forest System lands below 5,500 feet include 297,173 acres (15.9 percent) of old growth or replacement old growth (Table 143). About 10.7 percent (199,109 acres) of those lands were determined to be effective old growth, and 5.2 percent (98,064 acres) were identified as replacement old growth.

The action alternatives would result in between 16.4 and 18.2 percent designated old growth below 5,500 feet elevation in the Crazy PSU, and 12.9 percent designated old growth below 5,500 feet elevation in the Silverfish PSU. The KFP established that maintaining 10 percent of old growth habitat is sufficient to support viable populations of old-growth dependent species (KFP, Vol. 1, II-1, 7, III-54; Vol. 2, A17).

Other applicable standards established in the KFP for MA 13 (Designated Old Growth) include:

- Recreation: All action alternatives would comply with these standards. A forest closure order exists to off-highway vehicles, which restricts the off-highway vehicles to established roads and trails.

- Wildlife and Fish: All action alternatives would comply with these standards. Activities that potentially conflict with grizzlies in Management Situation 1 and 2 grizzly habitat are described in section 3.24, *Wildlife Resources*.

- Soil, Water, and Air: All alternatives would comply with these standards. As described in sections 3.18, *Soils and Reclamation* and 3.4, *Air Quality*, all action alternatives would be in compliance with soil standards in the KFP and MAAQS. For all action alternatives, BMPs would be implemented to reduce erosion and sedimentation.

- Riparian: Compliance with INFS standards have been discussed in section 3.6, *Aquatic Life and Fisheries*.

- Timber: Firewood cutting could impact snags located in old growth habitat, and this effect is taken into consideration in the cavity habitat analysis in section 3.24, *Wildlife Resources*. Timber harvest would occur, as shown in Table 145 and Table 146. All action alternatives require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment to change the current MA 13

(Designated Old Growth) designation of all harvested stands to either MA 23 (Electric Transmission Corridor) or 31 (Mineral Development).

- Facilities: All action alternatives would comply with these standards. Some areas of MA 13 would be reallocated to MA 31 (Mineral Development) or MA 23 (Electric Transmission Corridor) for each action alternative. For all action alternatives, some currently closed or restricted roads would be open to mine traffic, but would not be accessible to the public (see Table 9 for Alternative 2, Table 17 for Alternative 3, Table 30 for Alternative 4). All action alternatives would continue to restrict motorized access on other local roads where closures exist.

3.21.2.4.13 Irreversible and Irretrievable Commitments

All action alternatives would result in an irreversible commitment of old growth forest in the Crazy PSU and in small areas of private land along the transmission line corridor near U.S. 2. No direct effects on old growth habitat would occur in the Silverfish PSU. Irretrievable commitments of old growth resources in the Silverfish PSU would occur due to indirect impacts from minor edge effects resulting from Alternative E. The recovery time of old growth forest would preclude restoration for centuries following disturbance.

3.21.2.4.14 Short-term Uses and Long-term Productivity

Losses of old growth habitat resulting from implementation of the action alternatives would be long-term, and would be limited to the Crazy PSU and small areas of private land along the transmission line corridor near U.S. 2. Alternative E would result in minor edge effects, which would continue beyond the reclamation phase. If reclamation were successful and successional processes were allowed to take place, edge effects would eventually dissipate. Given the recovery time of old growth forest, edge effects would likely require centuries following disturbance to be eliminated.

3.21.2.4.15 Unavoidable Adverse Environmental Effects

Unavoidable adverse effects would occur from all action alternatives in the Crazy PSU and small areas of private land along the transmission line corridor near U.S. 2 where old growth habitat would be directly removed. Edge effects from Alternative E also would be an unavoidable adverse effect to old growth habitat.

3.21.3 Threatened, Endangered, and Sensitive Plant Species

The KNF monitors plant species considered to be of concern. Plant species of concern are characterized as threatened, endangered, sensitive, or Category 4 watch species. T&E species include species listed by the USFWS and protected under the ESA. Forest sensitive species are those species the Regional Forester determines to be a concern on National Forest System lands in the Region due to declining numbers. The KNF works closely with the Montana Natural Heritage Program (MNHP), which maintains records of plant species of concern. State listed plant species of concern are also discussed in the following sections.

3.21.3.1 Regulatory Framework

Section 3.6, *Aquatic Life and Fisheries* discusses the regulatory framework for federally listed threatened or endangered plant species, and Forest sensitive plant species. One Forest sensitive and state listed plant species of concern was found in the analysis area, the northern beechfern

(*Thelypteris phegopteris)*. The KFP requires the maintenance of diverse age classes of vegetation for viable populations of all existing native, vertebrate wildlife species.

There are no regulatory requirements to protect Forest sensitive or state plant species of concern on private land. The DEQ strives to work with proponents of mine development to voluntarily limit impacts to Forest sensitive or state plant species of concern. The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives.

3.21.3.2 Analysis Area and Methods

The analysis area consists of all areas that would be disturbed by facility construction under any alternative (Figure 83). Potential habitat for sensitive plants was surveyed in areas surrounding facilities as proposed in 1989. Sensitive plant surveys followed KNF guidelines and procedures and were conducted during the summers of 1988 and 1989 (Western Resource Development 1989d, 1989e), with additional updates in the summer of 2005 (Westech 2005c). During the sensitive plant survey, habitats for sensitive plants were thoroughly examined and the remainder of the analysis area was less thoroughly examined (Westech 2005c). Additional sensitive plant inventories of the Poorman Tailings Impoundment Site, the Libby Plant Site, and the Upper Libby Adit Site were conducted in June and August of 2007 (Geomatrix 2007e). Surveys for sensitive plants were not completed for Alternative E - West Fisher Creek Alternative, a segment of Alternative D - Miller Creek Alternative in upper Miller Creek, segments of Alternative C – Modified North Miller Creek Alternative where they differ from Alternative B, and the segment in Alternatives C, D, and E from the Sedlak Park Substation north to where the alignment crosses Alternative B.

Information from these surveys was used to determine effects on plant species of concern. MNHP records are used in this summary to describe the characteristics of plant species of concern found during surveys of the analysis area. No surveys specifically for Category 4 watch species were conducted in the analysis area. Category 4 watch species were identified and recorded during surveys and are included in vascular plant species lists identified in the analysis area (Westech 2005c) and are not discussed further.

3.21.3.3 Affected Environment

Two federally listed threatened plant species and one candidate species were identified to potentially occur in the analysis area: water howellia (*Howellia aquatilis*), Spalding's campion (*Silene spaldingii*), and linearleaf moonwort (*Botrychium lineare*). Suitable habitat for federally listed or candidate species was evaluated and determined to be limited in the analysis area (Westech 2005c). No federally listed T&E plant species have been found in the analysis area and T&E plant species are not discussed further.

One Forest sensitive and state listed plant species of concern was found in the 2005 inventory, the northern beechfern (*Thelypteris phegopteris*). Northern beechfern is found at 18 locations in scattered populations in the northwestern Montana in Flathead, Glacier, Lincoln, and Sanders counties (MNHP 2008). Three of the 18 occurrences are on the Libby Ranger District of the KNF (MNHP 2006a). Northern beechfern is found in populations (ranging from 10 to 100 individuals) on benches above Little Cherry Creek in the analysis area (Westech 2005c). The northern beechfern is a sensitive species due to a combination of rarity, limited distribution within the

Northern Region, and potential habitat loss (MNHP 2006a). The MNHP has classified the northern beechfern as secure globally, but imperiled in Montana because of rarity within the state. Habitat characteristics for the northern beechfern include old growth and mature western red cedar and western hemlock, which occur in the coniferous forest community. Understory plants found with northern beechfern are queencup beadlily, devil's club and lady fern. Management goals for northern beechfern population and genetic viability associated with each are discussed in the KNF Conservation Assessment Report prepared as a result of the 1992 EIS completed for the Montanore Project (KNF 1993).

3.21.3.4 Environmental Consequences

3.21.3.4.1 Alternative 1 – No Mine

The No Mine Alternative would not affect any Forest sensitive or other state listed plant species of concern.

3.21.3.4.2 Alternative 2 – MMC's Proposed Mine

Under Alternative 2, one Forest sensitive and state listed plant species of concern plant population would be affected, the northern beechfern. The northern beechfern population is located in a long slender band along the Little Cherry Creek Tailings Impoundment Site adjacent to Little Cherry Creek. The population would be eliminated during impoundment construction.

3.21.3.4.3 Alternative 3 – Agency-Mitigated Poorman Impoundment Alternative

Alternative 3 would not affect any Forest sensitive and state listed plant species of concern.

3.21.3.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The effect on Forest sensitive and state listed plant species of concern for Alternative 4 would be the same as Alternative 2.

3.21.3.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.21.3.4.6 Alternatives B, C, D, and E

No Forest sensitive or other state listed plant species of concern were identified along the transmission line corridors surveyed. Surveys for Forest sensitive and state listed plant species of concern were not conducted for portions of Alternative C –Modified North Miller Creek that differ from Alternative B, the west spur of Alternative D – Miller Creek, Alternative E – West Fisher Creek, and the southern spur to Sedlak Park Substation. Prior to final design and any ground-disturbing activities, MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have not been completed that would be disturbed by the alternative. Similarly, MMC would conduct surveys for threatened, endangered, and state-listed plant species potentially occurring on non-National Forest System lands. Results of the surveys would be submitted to the agencies for review and comment. If adverse effects could not be avoided, MMC would develop appropriate

mitigation plans for the agencies' approval. The mitigation would be implemented before any ground-disturbing activities. To the extent feasible, MMC would make adjustments to structure and road locations, and other disturbing activities to reduce impacts.

3.21.3.4.7 Cumulative Effects

No other reasonably foreseeable projects in the region, including the Miller-West Fisher Vegetation Management Project, would directly impact federally listed, Forest sensitive, or state listed plant species of concern.

3.21.3.4.8 Regulatory/Forest Plan Consistency

No federally listed plant species were found in the analysis area. None of the alternatives would likely cause a trend to federal listing or loss of species viability of the northern beechfern. All alternatives would be in compliance with the KFP.

3.21.3.4.9 Irreversible and Irretrievable Commitments

An irretrievable commitment of resources would occur for all mine action alternatives from the loss of one population of Forest sensitive and state listed plant species of concern. Reclamation of habitat upon completion of mining may provide conditions suitable for establishment of affected species. Increases in populations of introduced species after disturbance may limit the potential for re-establishment of these species.

3.21.3.4.10 Short-term Uses and Long-term Productivity

Mine operations would result in both a short-term and long-term loss of one population of Forest sensitive and state listed plant species of concern under all action alternatives. Reclamation of habitat following mining may provide habitat for affected species. Increases in populations of introduced species after disturbance may limit the potential for re-establishment of these species.

3.21.3.4.11 Unavoidable Adverse Environmental Effects

Long-term loss of one small populations of Forest sensitive and state listed plant species of concern would occur for all mine action alternatives. None of the transmission line alternatives would affect sensitive plant populations.

3.21.4 Noxious Weeds

3.21.4.1 Regulatory Framework

Noxious weeds are defined by the Forest Service as "those plant species designated as noxious weeds by the Secretary of Agriculture or by the responsible state official. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease and being not native, or new to, or not common to the United States or parts thereof" (USDA Forest Service 2001).

The Montana County Weed Control Act (MCA 7-22-2101 *et seq.*) defines noxious weeds as "any exotic plant species established or that may be introduced in the state which may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities and that is designated a state noxious weed by rule of the Department of Agriculture; or a noxious weed by a county board." It also states that it is unlawful for any person to permit any noxious weed to propagate or go to seed on his land. The KNF has signed a memorandum with Lincoln County and has agreed to assist and cooperate with the Lincoln

County Weed District in managing noxious weeds. The Forest Service's guidelines for controlling noxious weeds are provided in the FSM 2080 Noxious Weed Management Handbook (USDA Forest Service 2001) and Appendix A of the KNF Invasive Plant Management Final EIS (KNF 2007a). The Lincoln County Weed District has identified several species of noxious weeds that occur or potentially occur in Lincoln County (Lincoln County 2004).

3.21.4.2 Analysis Area and Methods

The analysis area for noxious weeds includes all the mine-related facilities, roads, and transmission line alignments that would potentially be disturbed by mine and transmission line construction and operations (Figure 83).

Noxious weed baseline surveys for the Montanore Project facilities as proposed in 1989 were conducted during the summers of 1988 and 1989 (Western Resource Development 1989d, 1989e). Noxious weed surveys were updated in 2005 to determine if the weed species or distribution had changed (Westech 2005b). Most proposed mine facility locations and transmission line alternatives were surveyed for noxious weeds. The following areas were not surveyed: the majority of the Poorman Impoundment Site (Alternative 3), the Libby Plant Site (Alternatives 3 and 4), the Upper Libby Adit Site (Alternatives 3 and 4) and West Fisher Creek (Alternative E). Areas not evaluated for noxious weeds are believed to have similar noxious weed infestations and would require similar control methods.

The potential for noxious weed introduction and establishment for the alternatives evaluated was determined based on existing weed populations, total amount of disturbance, and plans to control weeds and revegetate disturbed areas.

3.21.4.3 Affected Environment

Noxious weeds are categorized by the state, county, and Forest Service for management and control. Lincoln County categorizes noxious weeds in Categories I through IIIa (Lincoln County 2004). Lincoln County Category I species are weeds that cover large areas, but are not targeted for weed control. Lincoln County Category II species are both widespread and targeted for weed control management (Westech 2005b). Lincoln County Category IIIa species are potential invaders. They include noxious weeds that do not currently exist in Lincoln County but have a high probability of causing severe environmental or economic degradation. The State of Montana and KNF noxious weed plans (KNF Noxious Weed Handbook, Spring 2008, Edition 5.0) categorize noxious weeds into similar groups as Lincoln County, but different priorities. Noxious weed categories are listed in Table 148.

KNF Category 1 and 2, State Category 1 and 2, and Lincoln County Category I, II, and IIIa species were observed in several locations in the analysis area. Nine species of noxious weeds were found in the analysis area during the 2005 baseline vegetation studies: Canada thistle; spotted knapweed; ox-eye daisy; orange hawkweed; meadow hawkweed; St. Johnswort; sulfur cinquefoil; tall buttercup; and common tansy (Westech 2005b). The 1988 vegetation baseline inventory (Western Resource Development 1989d, 1989e) documented three listed noxious weeds in the analysis area as well as three noxious weeds yet to be officially listed: Canada thistle, spotted knapweed, St. Johnswort, orange hawkweed, ox-eye daisy, and tall buttercup. Meadow hawkweed, sulfur cinquefoil, and common tansy were not recorded in the initial mine analysis area in 1988, but were recorded in 2005.

Table 148. Noxious Weeds Found in the Analysis Area.

Weed Species	Scientific Name†	State Category	Lincoln County Weed Category	KNF Weed Category
Canada thistle	*Cirsium arvense*	1	II	1
Common tansy	*Tanacetum vulgare*	1	II	1
Meadow hawkweed	*Hieracium caespitosum*	2	I	1
Orange hawkweed	*Hieracium aurantiacum*	2	I	1
Ox-eye daisy	*Leucanthemum vulgare*	1	I	1
Spotted knapweed	*Centaurea stoebe*	1	I	1
St. Johnswort	*Hypericum perforatum*	1	I	1
Sulphur cinquefoil	*Potentilla recta*	1	I	1
Tall buttercup	*Ranunculus acris*	2	IIIa	2

†Scientific name from USDA NRCS 2008.

Canada thistle is a deep-rooted, creeping perennial that is native to Eurasia. In the analysis area, Canada thistle is common in disturbed swales, mesic areas, and in wetlands where logging has occurred. Monocultures characterized by a high density of Canada thistle are present as scattered plants with low concentrations (Westech 2005b).

Common tansy is a perennial forb that is poisonous if ingested. It is not as dominant as the other listed noxious weeds in the analysis area. This species is found most frequently along roads and in disturbed areas, and along riparian corridors. It is common in patches along the Fisher River (Westech 2005b).

Meadow hawkweed has almost identical vegetative growth characteristics to orange hawkweed and is difficult to distinguish without flowering heads. Meadow hawkweed is less common in the analysis area than orange hawkweed, and is found primarily along roads (Westech 2005b).

Orange hawkweed is a perennial with a fibrous, creeping root system. It has clusters of orange dandelion-like heads and is the most abundant and problematic noxious weed in the Montanore analysis area. It is found mostly in logged and disturbed areas in western hemlock/western red cedar forest types. Most roadsides are dominated by orange hawkweed (Westech 2005b).

Once a cultivated species, ox-eye daisy is an invasive weed that is becoming an increasing problem in the western states. Ox-eye daisy is most common along roads and in recently logged areas in the Montanore analysis area (Westech 2005b). It is invading many meadows in northwestern Montana.

Spotted knapweed is an aggressive invader that generally occurs in disturbed areas. Spotted knapweed is a perennial, taprooted Eurasian weed species that invades range and harvested forestland throughout the West. It can reduce biodiversity, wildlife and livestock forage production, and can also increase soil erosion (Montana Summit Steering Committee 2005). Spotted knapweed grows best in well-drained soils. Spotted knapweed occurs throughout the analysis area, particularly along roads, on disturbed areas, and in areas where timber has been harvested and tree canopy cover is relatively open. Undisturbed areas typically do not have large infestations of spotted knapweed (Westech 2005b).

St. Johnswort is a perennial species that was introduced because of its medicinal properties. Montana's Department of Agriculture reports that St. Johnswort covers an area of about 500,000 acres in Montana (Montana Summit Steering Committee 2005). This plant is unpalatable and mildly poisonous to livestock. It is observed along roads and in recent previously harvested coniferous forests but coverage was spotty or minor (Westech 2005b).

Sulfur cinquefoil is a perennial species with well-developed creeping woody roots. Sulfur cinquefoil was recorded in Sedlak Park and along U.S. 2 near the analysis area (Westech 2005b).

Tall buttercup is a perennial species that grows up to 3 feet tall and is poisonous to livestock if ingested. Tall buttercup was present in the 1988 baseline vegetation inventory but was not located during the 2005 baseline vegetation survey (Westech 2005b).

3.21.4.4 Environmental Consequences

3.21.4.4.1 Alternative 1 – No Mine

Introduced species and noxious weeds have increased in the analysis area between the time the baseline vegetation surveys were conducted in 1988 and 1989 and the time they were updated in 2005. This would continue in the future with or without the mine. The No Mine Alternative would not involve land-disturbing activities likely to increase the number and distribution of noxious weeds. Noxious weeds currently present in the analysis area would continue to be subject to existing Forest Service, state, and countywide weed management practices. Noxious weeds at the Libby Adit Site would continue to be controlled in accordance with existing permits and approvals. The Forest Service and other land mangers and owners are not required to control other introduced species.

3.21.4.4.2 Alternative 2 – MMC's Proposed Mine

Alternative 2 would increase the spread and establishment of noxious weeds and other introduced species associated with ground-disturbing activities. Weeds invade disturbed ground where they easily establish and out-compete native species even with a weed control program. Weed establishment would more likely occur along roads, cut and fill slopes, the margins of mine facilities, soil stockpiles, and other disturbed areas. The distribution of noxious weeds and other introduced species would probably be greatest under Alternative 2 because it includes the largest area of potential disturbance (2,581 acres).

MMC's weed control program would minimize weed infestations on lands disturbed by the proposed facilities. All off-highway vehicles and earth moving equipment entering Lincoln County would be washed at a commercial facility. Special emphasis would be taken to remove soil and other plant material from the vehicle or equipment. MMC would notify KNF at least 24 hours in advance of equipment delivering to the site to provide an opportunity to inspect the equipment. Weed control during operations would primarily be through the use of herbicides. Additionally, a 3-year continuous monitoring and treatment program would be implemented (MMI 2006). Criteria in the reclamation plan for Alternative 2 require that vegetation composition would have less than 10 percent cover of noxious weeds. MMC would not be required to control other introduced species.

3.21.4.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

With 2,011 acres of disturbance, Alternative 3 would have similar potential to increase the infestation and spread of noxious weeds and other introduced species as Alternative 2, although

distribution would likely be less. All weed BMPs discussed in section 2.5.5.2.5, *Noxious Weed Mitigation Measures* for Alternative 3 would be implemented, and would reduce the establishment and spread of noxious weeds, compared to Alternative 2. Weed BMPs would address the treatment and control of noxious weeds throughout all mine facilities.

The reclamation plan for Alternative 3 differs from Alternative 2 and would require that noxious weeds would have less than 10 percent cover of species listed as Category 1 (established infestations) and 0 percent cover of Category 2, and 3 (potential invaders and new invaders, as described in the KNF Noxious Weed Handbook, Spring 2008, Edition 5.0) in reclaimed areas. Category 1 noxious weeds would not dominate any location greater than 400 square feet. The goal of Alternative 3 would be to use a native seed mix, if commercially available, that would reduce the spread of invasive or noxious species. In Alternative 3, shrubs and trees would be planted by hand in random patterns to prevent the spread or infestation of noxious weeds by limiting disturbance from machinery. MMC would not be required to control other introduced species.

3.21.4.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would have the same potential to result in the establishment and spread noxious weeds and other introduced species as described for Alternatives 2 and 3. The reclamation and weed management plans for Alternative 4 would be the same as Alternative 3. MMC would not be required to control other introduced species.

3.21.4.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.21.4.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the largest area of surface disturbance associated with new or upgraded road construction and timber clearing of the four alternatives (Table 142). New roads would be reseeded as an interim measure, but would continue to be used for maintenance activities, as necessary. Surface disturbances and continued road use would increase the risk of noxious weed and other introduced species spread and would require more monitoring and control of noxious weeds. Alternative B would have the least area of vegetation clearing, which would minimize disturbance and associated weed spreading that would be the result of clearing. MMC's weed control program described in Alternative 2 would be implemented for Alternative B, and is designed to minimize weed infestations on lands disturbed by the proposed facilities. Vehicles would be cleaned before entering the area and following work in weed infested areas. BPA's plan to conduct a noxious weed survey at the proposed Sedlak Park Substation Site before and after construction of the substation and its weed control program would minimize noxious weeds at the site. MMC and the BPA would not be required to control other introduced species.

3.21.4.4.7 Effects Common to Transmission Line Alternatives C, D, and E

These alternatives would use a helicopter to construct between 20 and 23 structures, which would minimize new road construction or reconstruction. A helicopter would be used to clear timber in areas adjacent to core grizzly bear habitat. Roads placed in intermittent stored service or decommissioned would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. These modifications would reduce the risk of noxious weed spread. Because these alternatives would require greater vegetation clearing along the transmission line corridor, weed spread associated with such clearing would be greater in these alternatives than Alternative B. MMC's weed control program described in Alternative 2 and modified in Alternative 3 would minimize weed infestations on lands disturbed by the transmission line facilities. BPA's plan to conduct a noxious weed survey at the proposed Sedlak Park Substation Site before and after construction of the substation and its weed control program would minimize noxious weeds at the site. MMC would coordinate with the Forest Service Weed Specialist for use of biocontrol agents as they become available. MMC and BPA would not be required to control other introduced species.

3.21.4.4.8 Cumulative Effects

Past actions, particularly timber harvest, road construction and fire suppression, coupled with human activity have resulted in the establishment of the existing noxious weed and other introduced species populations in the analysis area. All reasonably foreseeable future projects in the area that involve ground disturbances have the potential to spread and increase the number of noxious weeds and other introduced species. Any ground-disturbing activities, activities that involve large equipment, livestock grazing, or activities that increase motor access could increase spread of noxious weeds or introduce new invaders to the area. Noxious weed and other introduced species infestations would impact sensitive plant species. The construction of both the Montanore Project and the Rock Creek Project would increase the opportunity for noxious weeds to invade the CMW from the east and west. All reasonably foreseeable actions would be subject to existing Forest Service, state, and county wide management practices, which have proven effective in slowing the spread of noxious weeds. The Forest Service and other land mangers and owners are not required to control other introduced species.

3.21.4.4.9 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would follow KNF BMPs and be in compliance with the Montana County Weed Control Act. All alternatives would be consistent with the KFP regarding noxious weed management.

3.21.4.4.10 Irreversible and Irretrievable Commitments

All alternatives would increase noxious weed and other introduced species populations, which would displace native species, and result in an irreversible loss of plant species.

3.21.4.4.11 Short-term Uses and Long-term Productivity

All alternatives would increase noxious weed and other introduced species populations, which would displace native species, and reduce their long-term productivity.

3.21.4.4.12 Unavoidable Adverse Environmental Effects

An unavoidable increase in weed and other introduced species populations would occur under all alternatives. Invasion of noxious weeds and other introduced species as well as spraying of noxious weeds with chemicals would result in the loss of some native plant species.

3.22 Wetlands and Other Waters of the U.S.

3.22.1 Regulatory Framework

Waters of the U.S. are defined broadly in the Corps' regulations to include a wide variety of waters and wetlands. The Corps defines "wetlands" as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328.3 (b)). Under natural conditions, waters of the U.S. provide food and habitat for fish and wildlife, flood protection, erosion control, water quality improvement, and opportunities for recreation (Adamus *et al.* 1991). The term "wetlands and other wetland waters of the U.S." includes both deep-water habitats (non-wetland) and special aquatic sites, which include wetlands (Environmental Laboratory 1987).

This section discusses wetlands and other waters of the U.S. found within the analysis area. In Montana, surface water is any water of the State at the surface of the ground, including but not limited to any river, stream, creek, ravine, coulee, undeveloped spring, lake, and other natural surface source of water regardless of its character or manner of occurrence (ARM 36.12.101). The Corps determines a water to be subject to its jurisdiction if the water body is a traditionally navigable water, relatively permanent, or a wetland that directly abuts a traditionally navigable or relatively permanent water body, or, in combination with all wetlands adjacent to that water body, has a significant nexus with traditionally navigable waters. (Corps and EPA 2007).

Federal agencies have the responsibility to avoid, minimize, and mitigate unavoidable effects to wetlands and waters of the U.S. under Section 404(b)(1) of the Clean Water Act and Executive Order 11990—Protection of Wetlands. All waters of the U.S. as well as activities that result in the discharge of fill material into wetlands or waters of the U.S. are regulated by the Corps. Based on a Supreme Court 2001 ruling, wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, do not fall under Corps' jurisdiction. The terms "isolated" and "non-jurisdictional" wetlands are used synonymously.

Projects subject to the Corps' jurisdiction also must comply with the 404(b)(1) Guidelines for discharge of dredged and fill material into wetlands and waters of the U.S. (40 CFR 230). It is anticipated that one or more Montanore Project facilities would need a 404 permit from the Corps. The 404(b)(1) Guidelines specify "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse affect on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative is considered practicable if "it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes." Practicable alternatives under the Guidelines assume that "alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise." The Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse affect on the aquatic ecosystem, unless clearly demonstrated otherwise" (40 CFR 230).

The KNF established standards for wetlands under the INFS standards (USDA Forest Service 1995). INFS standards and guidelines apply to an area within 150 feet of a wetland greater than 1

acre in size. For a wetland less than 1 acre, INFS standards and guidelines apply to an area within 100 feet of a wetland in priority watersheds, and within 50 feet of a wetland in non-priority watersheds.

3.22.2 Analysis Area and Methods

The analysis areas are areas where potential direct or indirect effects to wetlands and waters of the U.S. by any of the alternatives would occur. As part of a baseline inventory, MMC identified and delineated wetlands and other waters of the U.S. within the proposed permit area boundaries and along the transmission line corridors then under consideration (Westech 2005e). Wetland delineations for alternative sites for the Poorman Tailings Impoundment Site (Alternative 3), Libby Plant Site, and Upper Libby Adit (Alternatives 3 and 4) also were conducted (Geomatrix 2007e). Wetland delineations were not completed for Alternative E - West Fisher Creek Alternative, a segment of Alternative D - Miller Creek Alternative in upper Miller Creek, segments of Alternative C – Modified North Miller Creek Alternative where they differ from Alternative B, and the segment in Alternatives C, D, and E from the Sedlak Park Substation north to where the alignment crosses Alternative B. Wetland delineations also would be needed at sites proposed in the agencies' fisheries and wildlife mitigation measures, such as road crossings where culverts would be removed.

Using methods outlined in the 1987 Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987), MMC determined wetlands based on the presence of three wetland indicators: hydrophytic vegetation, hydric soils, and wetland hydrology. Wetland boundaries were flagged and delineated using a Global Positioning System (GPS) device. Waters of the U.S. not likely to be filled with dredged or fill material, or sites where GPS coverage was lacking, were delineated from aerial photo interpretation. This included wetlands along access roads and the powerline corridor, and on private lands.

MMC also delineated "isolated" or non-jurisdictional wetlands. Isolated wetlands have wetland hydrology, hydric soils, and hydrophytic vegetation, but are not typically connected by surface flow to jurisdictional waters of the U.S. Waters of the U.S. were delineated to the ordinary high water mark where stream channels had a defined bed and bank (Westech 2005e). The wetland delineation completed by Westech has been subject to a jurisdictional determination by the Corps (Westech 2005e). The Corps completed a preliminary jurisdictional determination of the wetland delineation of the Poorman Impoundment Site. An approved jurisdictional determination of isolated wetlands has not been completed (Corps 2008). In the effects analysis, the lead agencies used the Corps' preliminary jurisdictional determination of the Poorman Impoundment Site.

Wetlands near the Sedlak Park substation site were not delineated according to the 1987 Corps of Engineers Wetlands Delineation Manual. Instead BPA environmental staff identified wetland boundaries based on the presence of hydric soil boundaries, secondary hydrologic indicators, and wetland vegetation (BPA 2008). Wetland boundaries were recorded using a GPS device. GPS data was used by BPA to develop a substation design that would avoid and minimize impacts to wetlands and waters of the U.S. (BPA 2008).

Impacts of the mine alternatives on wetlands were determined by calculating the number of acres that would be disturbed. MMC's wetland mapping did not distinguish open water channels from adjacent wetlands along stream channels. For example, wetlands along Little Cherry Creek as well as the Little Cherry Creek channel were mapped as riverine wetlands. To differentiate effects

on wetlands from open water, open water and channel width were subtracted from the wetland information provided by Westech and Geomatrix and incorporated into the impact analysis. The average channel width of Little Cherry Creek is around 8 feet (Geomatrix 2006d). The average channel width of the four channels in the Poorman Tailings Impoundment Site is estimated to be 2 feet (Geomatrix 2006b).

3.22.3 Affected Environment

3.22.3.1 Wetlands and Waters of the U.S.

In the analysis area, wetlands are primarily located adjacent to low terraces, overflow channels, and scoured depressions along perennial streams. Wetlands are also found in depressions and low gradient swales in the two tailings impoundment sites (Figure 85). Springs, seeps, and runoff from snowmelt and precipitation result in soil saturation or inundation during spring and early summer. Sidehill and toeslope seeps are present along portions of Little Cherry Creek. These seeps range from small discrete trickles to more extensive zones of saturation along slopes where the seepage zone may extend for more than 100 feet. Sidehill and toeslope seeps are generally saturated late into the growing season.

3.22.3.1.1 Wetland Types

Functions and values for wetlands on the Montanore Project site were evaluated using the MDT evaluation method (Geomatrix 2007e, 2008d). The MDT method uses a classification system that combines the USFWS classification system (Cowardin *et al.* 1979) with a hydrogeomorphic (HGM) (landscape position) approach (Brinson 1993). The Montana Method provides a landscape context to the Service classification. The MDT method classifies wetlands as Category I, II, III, or IV. Category I wetlands are exceptionally high quality wetlands and are generally rare to uncommon. Category II wetlands are more common than Category I wetlands, and provide habitat for sensitive plants and animals. Category III wetlands are more common than Category II or I wetlands, generally less diverse, and are often smaller than Category II or I wetlands. Category IV wetlands are generally small, isolated, and lack vegetative diversity. These wetlands provide minor wildlife habitat.

Category I, II, and III wetlands were found in the project area. Category I wetlands were found in the Little Cherry Creek Impoundment Site (Geomatrix 2008d) and Category II and III wetlands were found in the Little Cherry Creek Impoundment Site and the Poorman Impoundment Site (Geomatrix 2007e, 2008d).

Forest-dominated wetland types (riverine forested, slope forested, slope depressional forested, and slope riverine forested) are primarily found along stream corridors and seeps. This wetland type is dominated by western redcedar, western hemlock, and Engelmann spruce. Understory species include devil's club, lady fern, oakfern, arrowleaf groundsel, and common horsetail (Westech 2005e and Geomatrix 2008d).

Scrub-shrub dominated wetlands (slope scrub-shrub and riverine scrub-shrub) support Douglas spirea, thinleaf alder, alder buckthorn, and common snowberry. Understory species include inflated sedge, brown bog sedge, bluejoint reedgrass and common horsetail. Scrub-shrub dominated wetlands are found along drainages where trees have been removed by logging, around depressions, in logged swales with poor drainage, and in oxbows of the Fisher River (Westech 2005e; Geomatrix 2008d).

Herbaceous-dominated wetlands (slope emergent and depressional emergent) are wet depressions or slope areas with poorly drained soils. Sedges such as inflated sedge, beaked sedge, and knot-sheath sedge are typically the dominant species with horsetails, rushes, and other graminoids being co-dominants (Westech 2005e; Geomatrix 2008d).

3.22.3.1.2 Other Waters of the U.S.

Streams and drainages within the analysis area are other waters of the U.S. (Geomatrix 2007e). Section 3.11, *Surface Water Hydrology* contains additional descriptions of these drainages: Fisher River, Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Howard Creek, Miller Creek, West Fisher Creek, Hunter Creek, Sedlak Creek, and other unnamed drainages.

3.22.3.1.3 Springs

The Corps defines springs as "any location where there is artesian flow emanating from a distinct point at any time during the growing season" (Corps 2002). In Montana, a spring is defined as a hydrologic occurrence of water involving the natural flow of water originating from beneath the land surface and arising to the surface of the ground. Any disturbances within 100 feet of a spring are regulated by the Corps (Corps 2002). Numerous springs are located in the analysis area. Spring types and locations are described in section 3.10, *Ground Water Hydrology*.

3.22.4 Environmental Consequences

3.22.4.1 Alternative 1 – No Mine

The No Mine Alternative would not disturb or affect any wetlands or waters of the U.S. Any existing wetland disturbances would be mitigated in accordance with existing permits and approvals.

3.22.4.2 Alternative 2 – MMC's Proposed Mine

3.22.4.2.1 Direct Effects

Mine Facilities

Alternative 2 would affect 33.5 acres of jurisdictional wetlands (Table 149). Most of these wetlands would be forested wetlands located in the proposed Little Cherry Creek Tailings Impoundment Site. Functional Category I, II, and III wetland types were found in the Little Cherry Creek Tailings Impoundment Site. About 0.6 acre of isolated wetlands found in small scattered locations in the Little Cherry Creek Tailings Impoundment Site would be affected. These isolated wetlands are generally small depressions resulting from logging activity (Westech 2005e). About 2.8 acres of waters of the U.S. would be affected under Alternative 2.

The 10,800-foot diversion of Little Cherry Creek, a water of the U.S., and the loss of the existing channel would affect waters of the U.S. A bridge would be used to access the Ramsey Plant site. Waters of the U.S. and wetlands in Ramsey Creek would not be affected.

Table 149. Wetlands and Waters of the U.S. within Mine Alternative Disturbance Areas.

Facility[†]	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment[§]	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment
Jurisdictional Wetlands			
Impoundment Site	32.8	9.0	33.1
Roads	0.7	0.7	0.7
Subtotal	**33.5**	**9.7**	**33.8**
Non-wetland Waters of the U.S.			
Impoundment Site	2.8	0.6	2.7
Subtotal Jurisdictional Wetlands and Waters of the U.S.	**36.3**	**10.3**	**36.5**
Isolated Wetlands			
Impoundment Site	0.6	3.3	0.6
Plant Site	0.0	0.1	0.1
Roads	<0.1	<0.1	<0.1
Subtotal	**0.6**	**3.4**	**0.7**
Total	**37.0**	**13.7**	**37.2**

All units are acres, rounded to the nearest 0.1 acre; subtotals may vary by 0.1 acre due to rounding.
[§]Two small jurisdictional wetlands and one small isolated wetland in the Poorman Impoundment Site were identified by the Corps in its preliminary jurisdictional determination. The exact size and location of these wetlands have not been determined.
[†]The LAD Areas and adits would not affect any wetlands or waters of the U.S. in any alternative; the Plant Site would not affect any jurisdictional wetlands or waters of the U.S. in any alternative; bridges would be constructed for road crossings and would not affect any non-wetland waters of the U.S.
Source: GIS analysis by ERO Resources Corp. using wetland data in Westech 2005e and Geomatrix 2007e.

Mitigation Measures

As part of Alternative 2, one of the possible fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. Wetland delineations at these sediment source areas have not been completed. Any wetlands and waters of the U.S. disturbed during the implementation of this mitigation are not listed in Table 149. If implemented, this mitigation in the short term would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. Over the long term, this mitigation may increase the function and values of any associated wetlands and would decrease sediment delivery to waters of the U.S.

3.22.4.2.2 Indirect Effects

The effect on wetlands, spring, and seep habitat overlying the mine would be the same in all mine action alternatives and difficult to predict (see section 3.10.4.2.1, *Mine Area*). The effect on plant species, functions, and values associated with the affected wetlands, springs, or seeps by a change

in water level would be best determined by relating plant species with water abundance and quality for monitoring and evaluation. Alternative 2 does not include a survey of plant species abundance (all species) prior to activity and subsequent plant species abundance and water monitoring of ground water-dependent ecosystems (GDEs) overlying the mine. Without this type of monitoring, mining-induced changes in water level or quality may result in an unidentified loss of species, functions, and values associated with the affected wetlands, springs, or seeps.

Several wetlands and springs are present between the proposed Little Cherry Creek Tailings Impoundment and Libby Creek. The pumpback well system needed to collect seepage not collected by the underdrain system would likely lower ground water levels and reduce ground water discharge to springs, seeps, and wetlands downgradient of the impoundment (see section 3.10.4.2.2, *Tailings Impoundment*). Surface flow in Little Cherry Creek downstream of the Seepage Collection Pond may cease during low flow periods. Wetlands in the area immediately adjacent to the creek may be altered by a reduction in surface and ground water flows. Species more tolerant of drier sites might replace species requiring very moist soil conditions. It is uncertain if reducing surface and ground water flows would affect the functions and values of wetlands downstream of the impoundment. MMC would monitor effects to existing wetlands downstream of the tailings impoundment. Monitoring of the downstream wetland areas would be completed annually for the first 5 years of mine operation. If functions and values of downstream wetlands were adversely affected, MMC, in cooperation with the lead agencies and the Corps, would develop additional wetland mitigation. This monitoring would not adequately detect potential changes to wetlands downstream of the tailings impoundment throughout the operation of the impoundment.

Temporary indirect effects to wetlands and waters of the U.S. would occur during construction of the proposed Little Cherry Creek Tailings Impoundment and associated facilities due to increased sediment contributions to wetlands and waters of the U.S. Proposed BMPs would reduce sediment contributions to wetlands and waters of the U.S.

3.22.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.22.4.3.1 Direct Effects

Mine Facilities

Alternative 3 would directly affect 9.7 acres of jurisdictional wetlands, 3.4 acres of isolated wetlands, and 0.6 acre of non-wetland waters of the U.S. (Table 149). Functional Category II and III wetland types were found in the Poorman Tailings Impoundment site. Because the Poorman Tailings Impoundment would not require diversion of a perennial stream, Alternative 3 would affect fewer wetlands compared to Alternatives 2 and 4.

Mitigation Measures

MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. Culverts along all access roads that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows. Any work in a RHCA along an access road would be completed in compliance with INFS standards and guidelines.

The Wildlife Mitigation Plan in Alternatives 3 and 4 includes 20.3 miles of proposed access changes during the evaluation phase and up to 20.1 miles of proposed access changes during the

construction phase in the Rock Creek, Libby Creek, and Miller Creek watersheds (Figure 36). Wetland delineations along the roads proposed for access changes have not been completed. MMC would build and maintain gates or barriers on the roads, and complete other activities so the roads would either be removed from service, or cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. In most cases, culverts would be removed; such removals would occur in active stream channels requiring instream work, structure placement, and fill removal.

The Fisheries Mitigation Plan in Alternative 3 includes implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources in the Libby Creek watershed, and the installation of structures in bull trout critical habitat in Libby Creek between Little Cherry Creek and Bear Creek (Figure 35). Additional structures would be installed in East Fork Bull River.

Any wetlands and waters of the U.S. disturbed during the implementation of these measures are not listed in Table 149. In the short term, these activities would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. After the activities were completed, and the roads became stabilized, these mitigation measures would increase the function and values of any associated wetlands and would decrease sediment delivery to waters of the U.S.

3.22.4.3.2 Indirect Effects

No springs, seeps, or wetlands have been identified below the Poorman Impoundment Site. A pumpback well system would not affect any springs, seeps, or wetlands below the impoundment.

In Alternatives 3 and 4, a GDE inventory and subsequent monitoring would be completed of a selected area overlying the proposed mine and adits and used to help evaluate indirect wetland effects. The inventory would include a vegetation survey to describe and document existing vegetation characteristics and establish “trigger” species. Trigger species would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring plan. An identified spring between the two LAD Areas (SP-21 see Figure 72) would be part of the hydrology monitoring plan (Appendix C). The mitigation would not alter the effect of Alternatives 3 and 4, but would assist in determining if an impact were occurring and the scale of any impact. Loss of jurisdictional wetland resources as a result of water level or quality changes would be mitigated offsite at a 2:1 ratio. Non-jurisdictional wetlands would be mitigated offsite at a 1:1 ratio. No springs or wetlands are located downgradient of the Poorman Tailings Impoundment Site. Other temporary indirect effects of construction would be the same as Alternative 2.

3.22.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

3.22.4.4.1 Direct Effects

Mine Facilities

Alternative 4 would directly affect 33.8 acres of jurisdictional wetlands, 0.7 acre of isolated wetlands, and 2.7 acres of other waters of the U.S. (Table 149). Most effects would be in the Little Cherry Creek Impoundment Site. Functional Category I, II, and III wetlands were found in the Little Cherry Creek Impoundment site. Other temporary indirect effects of construction would be the same as Alternative 2. The diversion channel for Little Cherry Creek would be a geomorphic-type diversion that would incorporate habitat components.

Mitigation Measures

The same mitigation measures described in Alternative 3 would be implemented in Alternative 4. Any wetlands and waters of the U.S. disturbed during the implementation of the mitigation measures are not shown in Table 149. In the short term, these activities would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. After the activities were completed, and the roads became stabilized, these mitigation measures would increase the function and values of any associated wetlands and would decrease sediment delivery to waters of the U.S.

3.22.4.4.2 Indirect Effects

A GDE inventory of an area overlying the mine area, subsequent monitoring of GDEs, and implementation of any mitigation would be completed in Alternative 4, as described in Alternative 3. In addition, flow from springs SP-02, SP-10, S-12, SP-14, SP-15, and SP-29 (Figure 41) would be measured twice in Alternative 4, once in early June when the area was initially accessible, and once between mid-August and mid-September 1 year before construction began. (Springs SP-02 and SP-15 would not be monitored if they were covered by impoundment facilities.) Samples from these springs would be collected 1 year before construction began and analyzed for selected water quality parameters. Sampling would be repeated every 2 years until tailings disposal ceased. At each spring, a vegetation survey would be completed 1 year before construction began; the survey and establishment of "trigger plants" would be the same as Alternative 3. At the LAD Areas, an identified spring between the two LAD Areas (SP-21 see Figure 72) would be part of the hydrology monitoring plan (Appendix C).

In Alternative 2, MMC would monitor unspecified wetlands downstream of the tailings impoundment annually for the first 5 years of mine operation. In Alternative 4, MMC would monitor three wetlands if not filled by project activities: LCC-24, LCC-25, and LCC-39 (Figure 41). MMC would use the procedures established for monitoring of wetland mitigation sites described in Alternative 3 to assess vegetation characteristics and establish "trigger" species. Trigger species would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring. Samples from any standing water in these three wetlands would be collected in mid-summer 1 year before construction began and analyzed for selected parameters. Sampling would be repeated in mid-summer every 2 years until tailings disposal ceased. The mitigation would not alter the effect of Alternative 4, but would assist in determining if an impact were occurring and the scale of any impact.

3.22.4.5 Alternative A – No Transmission Line

Because no construction would occur, the No Transmission Line Alternative would have no direct or indirect effects on wetlands or other waters of the U.S.

3.22.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

As a basis for comparing alternatives, acreage of all wetlands and other waters of the U.S. within the transmission line clearing area was calculated. Direct effects to wetlands and waters of the U.S. are expected to be mostly avoided by placement and location of the substation, loop line, and transmission structures outside of wetlands and waters of the U.S. Unavoidable wetland direct effects would be determined during final design. Direct and indirect effects to wetlands and waters of the U.S. may occur from road construction activities.

A total of 1.6 acres of wetlands would be within the Alternative B transmission line clearing area; an additional 8.2 acres would be other waters of the U.S. (Table 150). No isolated wetlands were identified within the clearing area of any transmission line alternative. Alternative B would have the least amount of wetlands within the clearing area. Less than 0.1 acre of wetlands and waters of the U.S. and would be affected by new or upgraded road construction. The need for culverts or other crossing types at waters of the U.S. would be determined during final design. Indirect effects to wetlands from road construction would be minimized by use of drive-through dips, open-top box culverts, waterbars or crossdrains, and implementation of BMPs. The BPA would avoid all wetlands at the Sedlak Park Substation Site.

Table 150. Wetlands and Waters of the U.S. along Transmission Line Alternatives.

Type	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Transmission Line Clearing Area[†]				
Jurisdictional Wetlands	1.6	2.0	2.0	2.0
Waters of the U.S.	8.2	1.2	10.2	9.2
Areas Disturbed by New or Upgraded Roads				
Jurisdictional Wetlands	<0.1	0.0	0.0	0.0
Waters of the U.S.	<0.1	<0.1	<0.1	<0.1

All units are acres, rounded to the nearest 0.1 acre

[†]Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (all other alternatives except for a short segment of the West Fisher Creek Alternative E that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.

Source: GIS analysis by ERO Resources Corp. using MMC data.

3.22.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

A total of 3.2 acres of wetlands and waters of the U.S. would be within the clearing area of Alternative C (Table 150). Of the 3.2 acres, about 2.0 acres would be wetlands and 1.2 acres would be waters of the U.S. Alternative C would have the least acreage of waters of the U.S. compared to the other alignments. Indirect and direct effects to wetlands and waters of the U.S. would be avoided where practicable during structure placement. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.22.4.8 Alternative D – Miller Creek Transmission Line Alternative

A total of 12.2 acres of wetlands and waters of the U.S. would be within the clearing area of Alternative D (Table 150). Of the 12.2 acres, 2.0 acres would be wetlands and 10.2 acres would be waters of the U.S. Alternative D would have more waters of the U.S. within the clearing area. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.22.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

A total of 2.0 acres of wetlands and 9.2 acres of other waters of the U.S. would be within the clearing area of Alternative E (Table 150). Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.22.4.10 Proposed Mitigation and Monitoring Plans

A variety of mitigation measures would be used to minimize wetland effects during construction and operation. These measures would include BMPs, such as silt fence, revegetation of disturbed areas, and restoration of temporary wetland effects. Placement of transmission line structures would likely avoid wetlands.

The Corps has established minimum ratios for compensatory mitigation in the Omaha District. Wetland establishment should be no less than 2:1 for all jurisdictional wetlands. Mitigation for streams should be at a 1:1 ratio. The stream must be the same length and width as the impacted stream area (Corps 2005). The Corps typically does not establish mitigation ratios for non-jurisdictional wetlands.

Available information for the mitigation sites was reviewed to estimate function categories that are consistent with those used for existing wetlands at the Montanore site (Geomatrix 2008c). For wetland mitigation sites greater than 5 acres (Ramsey site and one South Poorman site), the wetland functions and values are Category II; for wetland mitigation sites less than 5 acres (North Poorman site, Little Cherry site, and one South Poorman site), the wetland functions and values are Category III (Geomatrix 2008c).

3.22.4.10.1 Alternative 2 – MMC's Proposed Mine

MMC has developed a conceptual Wetland Mitigation Plan designed to replace wetlands lost from project activities as described in section 2.4.6.1, *Wetland Mitigation Plan*. Wetland mitigation would involve on-site and off-site locations. MMC proposes to replace forested and herbaceous wetlands at a 2:1 ratio and herbaceous/shrub wetlands at a 1:1 ratio. Annual monitoring of mitigation sites would ensure mitigation sites were dominated by hydrophytic vegetation and had comparable function and value to the affected wetlands. MMC's proposed monitoring plan is described in section 2.4.6.1.3, *Monitoring*. Vegetation, soils, and hydrology data would be collected annually until the Corps has determined that wetland mitigation success was achieved. On-site mitigation opportunities would involve wetland restoration and wetland creation. Opportunities for wetland mitigation include sites along Little Cherry Creek. A total of 8.8 acres of on-site mitigation is proposed for Alternative 2 (Table 151) (Figure 21). Off-site mitigation would occur outside the permit area boundary. A total of 35.8 acres of off-site mitigation would mitigate for effects associated with Alternative 2 (Table 151). Most mitigation sites would be located in the Poorman Creek area. The Corps would be responsible for developing final mitigation ratios, depending on the function and values of the affected wetlands. Replacing herbaceous/shrub wetlands at a 1:1 ratio would not meet the minimum Corps mitigation ratio (Corps 2005).

3.22.4.10.2 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The agencies' Wetland Mitigation Plan for Alternative 3 is described in section 2.5.7.1, *Wetland Mitigation*. Alternative 3 would have the highest (17.5 acres) on-site mitigation compared to the other alternatives. Most mitigation for Alternative 3 would be located at the South Little Cherry

Creek site (15.3 acres) (Figure 34). Jurisdictional wetlands would be replaced at a ratio described in Alternative 2 while non-jurisdictional wetlands would be replaced at a 1:1 ratio. Shallow wells would be used to assess whether ground water is adequate to support wetlands if the mitigation sites were excavated to near the ground water surface. Only sites with adequate existing ground water available to support wetlands would be used for mitigation. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas. Use of existing wetland soils in mitigation would improve mitigation success. A total of 6.7 acres of wetland mitigation would be available off-site for Alternative 3 along the Ramsey Creek mitigation site. According to MMC, the Ramsey Creek mitigation site is part of an existing man-made wetland. MMC would conduct a wetland delineation of the proposed area during final design to ensure the wetland is jurisdictional. The Corps would be responsible for developing final mitigation ratios within the mitigation plan, depending on the function and values of the affected wetlands. Sufficient mitigation sites have been identified to achieve the Corps' minimum ratios.

The agencies' wetland monitoring plan for Alternative 3 is described in section 2.5.7.1.2, *Monitoring of Wetland Mitigation Sites*. The revised monitoring plan would better evaluate the functions and values of the mitigation sites.

3.22.4.10.3 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The agencies' Wetland Mitigation Plan for Alternative 3 is described in section 2.6.6.1, *Wetland Mitigation*. Alternative 4 would have 2.2 acres of on-site mitigation available along Little Cherry Creek (Table 151) (Figure 34). Jurisdictional wetlands would be replaced at a ratio described in Alternative 2 while non-jurisdictional wetlands would be replaced at a 1:1 ratio. A total of 33.8 acres of off-site mitigation would be available for Alternative 4. Off-site mitigation is comparable to Alternative 2. The Corps would be responsible for developing final mitigation ratios, depending on the function and values of the affected wetlands. Mitigation sites identified for Alternative 4 are insufficient to achieve the Corps' minimum ratios, and additional mitigation sites would be necessary if this alternative were permitted.

Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas. Use of existing wetland soils in mitigation would improve mitigation success.

According to MMC, the Poorman Weather Station mitigation site is not within an area of existing wetlands and has no well-defined drainage. Wetlands created at this site may not be jurisdictional if the site did not have a hydrologic connection to a jurisdictional water. If the wetlands adjacent to the proposed mitigation sites were not jurisdictional, additional mitigation sites would be developed.

In Alternative 2, MMC would use ground water collected from beneath the Little Cherry Creek Tailings Impoundment to create and maintain wetlands at one or more sites. Ground water beneath the tailings impoundment may be mixed with tailings water, and contain elevated nutrients and metal concentrations. Use of ground water beneath the tailings impoundment would not provide hydrologic support after operations cease. As proposed in Alternative 3, 1 year of ground water monitoring at the mitigation sites would be implemented in Alternative 4. Only sites with adequate existing ground water available to support wetlands would be used for mitigation.

Table 151. On- and Off-site Wetland Mitigation Opportunities by Alternative.

Mitigation Type and Site Name	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment
On-Site			
Little Cherry Creek	2.2	2.2	2.2
Little Cherry Creek Diversion Channel	1.6	0.0	0.0
South Little Cherry Creek	0.0	15.3	0.0
Unspecified Little Cherry Creek Site	5.0	0.0	0.0
Total On-Site	**8.8**	**17.5**	**2.2**
Off-Site			
North Poorman Creek	3.4	0.0	3.4
South Poorman Creek	9.7	0.0	9.7
Poorman Weather Station	14.0	0.0	14.0
Libby Creek Recreational Gold Panning Area	2.0	0.0	0.0
Ramsey Creek	6.7	6.7	6.7
Total Off-Site	**35.8**	**6.7**	**33.8**
Total Mitigation	**44.6**	**24.2**	**36.0**

All units are in acres rounded to the nearest 0.1 acre.
Wetlands mitigation sites are shown for Alternative 2 on Figure 21 and for Alternatives 3 and 4 on Figure 34.
Source: GIS analysis by ERO Resources Corp. using MMC data.

The agencies' wetland monitoring plan for Alternative 4 is similar to Alternative 3, as described in section 2.6.6.1.2, *Monitoring of Wetland Mitigation Sites*. Additional monitoring for Alternative 4 is described in section 2.6.5.1, *Ground Water Dependent Ecosystem Inventory and Monitoring*. In Alternative 4, flow from springs SP-02, SP-10, S-12, SP-14, SP-15 and SP-29 (Figure 41) would be measured and sampled for selected water quality parameters. MMC would monitor three wetlands if not filled by project activities: LCC-24, LCC-25, and LCC-39 (Figure 41). MMC would use the procedures established for monitoring of wetland mitigation sites described in Alternative 3 to describe and document existing vegetation characteristics and establish trigger species. Trigger species would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring plan. Samples from any standing water in these three wetlands would be collected and analyzed for selected water quality parameters. Sampling would be repeated in mid-summer every 2 years until tailings disposal ceased. The revised monitoring plan would better evaluate the functions and values of the mitigation sites and the effects on downstream springs and wetlands.

3.22.4.11 Cumulative Effects

Past actions in the analysis area, particularly road construction, has resulted in the placement of culverts and other fill material in streams and adjacent wetlands. Past actions after the passage of the Clean Water Act in 1977 were subject to Section 404 permitting and mitigation requirements. These past actions have unlikely affected the overall function and values of the wetlands within

analysis area ecosystems. Cumulative direct and indirect effects to waters of the U.S. may result from other reasonably foreseeable actions in the analysis area such as other mining operations and road construction. All present and reasonably foreseeable future actions would be subject to Corps' permitting and mitigation requirements. With appropriate mitigation, cumulative direct wetland effects would be negligible. Cumulative indirect effects from reasonably foreseeable future actions in the area may include small amounts of increased sedimentation in wetlands from new roads associated with construction and ground-disturbing activities such as Miller-West Fisher Vegetation Management Project, and projects on private land such as housing development, roads, and logging.

3.22.4.12 Regulatory/Forest Plan Consistency

All of the action alternatives would involve the discharge of fill material or excavation into wetlands or waters of the U.S. As mentioned in section 3.22.1, *Regulatory Framework*, the Corps regulates these activities under Section 404 of the Clean Water Act. MMC would apply for a permit and be required to follow conditions in the Section 404 permit. Plans for avoidance, minimization, and mitigation of effects to wetlands would be required prior to permit issuance. The Corps will discuss compliance with the 404(b)(1) Guidelines in its ROD for its decision on the Section 404 permit. Any alternative permitted by the Corps would comply with the KFP.

3.22.4.13 Irreversible and Irretrievable Commitments

All action alternatives would result in an irretrievable commitment of wetlands and other waters of the U.S. Successful mitigation would restore lost wetlands and provide similar functions and values to altered wetlands at another location. All action alternatives would affect wetlands and create changes in wetland functions and values. Some biodiversity in wetlands may ultimately be lost from invasion of introduced species and be irreversible under all action alternatives. Any differences in the function and values of the existing Little Cherry Creek channel and the proposed diversion channel in Alternatives 2 and 4 would be an irretrievable commitment.

3.22.4.14 Short-term Uses and Long-term Productivity

Short-term effects to wetlands and waters of the U.S. would occur during construction activities due to increased sediment contributions. Proposed BMPs would minimize sedimentation. Other potential short-term effects would result from time delays between the loss of existing wetlands resources and the development of the viable wetlands with similar functions and values.

3.22.4.15 Unavoidable Adverse Environmental Effects

A loss of wetland functions and values, biodiversity, and species composition would occur in all action alternatives where wetlands are affected. All wetlands would be mitigated and wetland functions and values would return to the area in time. Wetlands biodiversity and species composition would not return to predisturbance levels.

3.23 Wilderness and Inventoried Roadless Areas

3.23.1 Regulatory Framework

3.23.1.1 Wilderness

The Wilderness Act directs the Forest Service to protect the natural character of the wilderness and to provide for recreational, scenic, scientific, educational, cultural, and historical uses of wilderness areas. Based on the Wilderness Act's definition of wilderness, the Forest Service uses four attributes to describe wilderness:

- Natural integrity
- Apparent naturalness
- Outstanding opportunities for solitude
- Opportunities for primitive recreation

Natural integrity is the extent to which long-term ecological processes are intact and operating. Apparent naturalness focuses on how the area is perceived by the general public. Solitude is isolation from sights, sounds, and the presence of others. Primitive recreation provides opportunities for isolation from the evidence of man and may involve a high degree of challenge or risk and honed outdoor skills. These attributes are applied to the conditions inside the boundaries of the wilderness. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not regulate activities outside the wilderness.

3.23.1.2 Inventoried Roadless Areas

Inventoried roadless areas (IRAs) are defined as "undeveloped areas typically exceeding 5,000 acres that met the minimum criteria for wilderness consideration under the Wilderness Act and that were inventoried during the Forest Service's Roadless Area Review and Evaluation (RARE II) process, subsequent assessments, or forest planning" (USDA Forest Service 2003b). In 2001, the USDA adopted the Roadless Area Conservation Rule (36 CFR 294), which established prohibitions of road construction and reconstruction and timber harvesting in IRAs on National Forest System lands, with certain exceptions. On August 12, 2008, the Federal District Court for the District of Wyoming, declared that the 2001 Roadless Area Conservation Rule was promulgated in violation of the NEPA and the Wilderness Act. The court held "the roadless rule must be set aside" and that "[t]herefore, the Court ORDERS that the Roadless Rule, 36 CFR §§ 294.10 to 294.14, be permanently enjoined, for the second time." Previously, the Federal District Court for the Northern District of California issued an order that reinstated the 2001 roadless rule, including the Tongass-specific amendment, and specified that "federal defendants are enjoined from taking any further action contrary to the [2001] Roadless Rule....." On December 2, 2008, the Federal District Court for the Northern District of California issued an order in which "the Court partially stays its injunction as to states outside the Ninth Circuit and New Mexico, pursuant to Rule 62(c). The injunction remains in full effect in all other respects."

The IRAs are areas identified by the Forest Service for consideration of their suitability for inclusion in the National Wilderness Preservation System. Attributes of IRAs include primitive

recreation opportunities, opportunities for solitude, natural integrity and appearance, manageability and boundaries, and special features (USDA Forest Service 1993).

3.23.2 Analysis Area and Methods

3.23.2.1 Analysis Area

The analysis area encompasses the CMW located west of all proposed surface facilities in all alternatives, and the Cabinet Face East IRA just east of the CMW (Figure 86). Although other IRAs are shown on Figure 86, they would not be affected by any of the alternatives, and are not discussed further.

3.23.2.2 Methods

Potential effects to the CMW were qualitatively evaluated based on potential impacts to wilderness attributes from the proposed project. The analysis of effects on IRAs was qualitatively based on indirect effects on IRA attributes and quantitatively based on direct effects on IRAs. Data on the IRA attributes were taken from the KFP (USDA Forest Service 1987).

3.23.3 Affected Environment

3.23.3.1 Cabinet Mountains 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 (Figure 86). The wilderness occupies the upper elevations of the Cabinet Mountains, with elevations from 2,500 to 8,700 feet. The Cabinet Mountains are a north/northwest trending extensively glaciated mountain range. This glaciation has produced spectacular features such as high craggy peaks, vertical cliffs, knife-edge ridges, amphitheater-like basins, and filled valley bottoms. These land-building processes also have created many streams and about 85 lakes within the wilderness.

3.23.3.1.1 Wilderness Attributes

Natural integrity is the extent to which long-term ecological processes are intact and operating. This attribute describes how human influences alter natural processes by comparing an area's condition to its probable state after human contact. Apparent naturalness is closely related to natural integrity. Both qualities may be altered by the same activities. Apparent naturalness focuses on how the activities are perceived by the general public. The CMW has a high degree of existing natural integrity and apparent naturalness. Vegetation in the CMW is abundant and varied, ranging from delicate harebells growing in rock fissures to the lush, valley bottom stands of old growth cedar and hemlock. Thirteen species of conifer trees, 130 species of wildflowers, and numerous shrub species are known to grow in the wilderness. Many wildlife species inhabit the area within and adjacent to the wilderness. These include the grizzly bear, black bear, elk, bighorn sheep, mountain goats, lynx, mule deer, white-tailed deer, and various small mammals and birds.

Solitude is isolation from sights, sounds, and the presence of others. The developments and evidence of man do not appear. Features that contribute to solitude include size of area and distance from perimeter to center. Vegetation and topographic screening are also related to solitude. The narrow configuration of the CMW (less than a mile wide at its narrowest point) has

caused some pressures to occur at some of the more popular destination sites, such as Leigh Lake. The relatively easy access has also resulted in some sites receiving heavy use and visitor impacts.

Primitive recreation provides opportunities for isolation from the evidence of man. Visitors may enjoy a high degree of challenge and risk, and use of outdoor skills. The CMW offers opportunities for primitive recreational activities in a pristine setting. Hiking is the most popular activity in the wilderness. Fishing, photography, and hunting are the next most common activities pursued by wilderness visitors. The wilderness is split between Sanders and Lincoln counties. Access from the Lincoln County side is provided by 12 trails that are maintained on 1- to 2-year intervals and 19 trails are maintained on 3- to 4-year intervals. Access from the Sanders County side is provided by nine maintained trails and six trails not regularly maintained.

3.23.3.1.2 Management

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

Opportunity Class I includes pristine areas of the wilderness that are without recreation trails. Game trails or other obvious ways or routes may have light use by backpackers; almost no stock use occurs. Many remote basins and valleys without fishable lakes, combined with little evidence of recreational use, leads to abundant opportunity for solitude.

Opportunity Class II includes a delineation of trail corridors and more heavily used lake basins. Several lakes in this class are stocked with fish and have relatively easy access. In the analysis area, the lake basins and the trail corridors accessing them total less than 15 percent of the wilderness acres but account for most of the recreation use. Some of the heavily used lakes in the analysis area are Leigh, Rock, and Geiger. Campsites in Class II have developed from repeated visitor use of the same place. These are often in poor locations, impacting both the biological and social environment. A typical lake basin in the wilderness has two to five recognizable campsites. Use patterns and activities have resulted in eroding trails, bare compacted soils, damaged vegetation, campfire remnants, litter, and sanitation problems. Management emphasis is on rehabilitation of overused areas, obliteration of unacceptable sites, information dissemination, and education of wilderness users to prevent further degradation (USDA Forest Service and DEQ 2001).

In 2005, the Forest Service established a monitoring framework for wilderness that includes four qualities. These four qualities set a foundation for future monitoring:

- Untrammeled – wilderness is essentially unhindered and free from modern human control or manipulation
- Undeveloped – wilderness is essentially without permanent improvements or modern human occupation
- Natural – wilderness ecological systems are substantially free from the effects of modern civilization

- Outstanding opportunities for solitude or a primitive and unconfined type of recreation – wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge

3.23.3.2 Inventoried Roadless Areas

The Cabinet Face East IRA lies just east of the CMW and extends about 36 miles south from Libby (Figure 86). The area includes about 50,200 acres of National Forest System lands and about 800 acres of private lands. The average width is about 2 miles. This IRA provides attributes and recreational opportunity similar to those found in the CMW. The Forest Service identified the following attributes for the Cabinet Face East IRA (USDA Forest Service 1987).

3.23.3.2.1 Natural Integrity and Appearance

The Cabinet Face East IRA excludes most improvements and all roads, leaving it very natural appearing. Only one man-made feature within the IRA is noticeable, the Scenery Mountain Lookout.

3.23.3.2.2 Opportunities for Solitude

The Cabinet Face East IRA offers abundant opportunities for solitude due to the relatively low annual visitation and the lack of motorized roads.

3.23.3.2.3 Primitive Recreation Opportunities

Primitive recreation opportunities available in the Cabinet Face East IRA include hiking, hunting, stream fishing, and horseback riding. Challenging experiences are available such as rock climbing on the steep rock faces and cross-country ski touring, primarily in the south half of the roadless area.

3.23.3.2.4 Roadless Area Manageability and Boundaries

Cabinet Face East IRA is a long, linear roadless area with boundaries easily defined in some places and less so in others. Less definable boundaries are due to the exclusion of some narrow drainage corridors on the eastern side where roads exist. The IRA spans the length of the CMW on its east side and provides a buffer zone to it, making the CMW more manageable for wilderness characteristics.

3.23.3.2.5 Special Features

The Cabinet Face East IRA has many special features including grizzly bear, goat, and moose habitat and views of historical mining activity. Ramsey Lake, a very small lake surrounded by old growth, is also a special scenic feature within the analysis area. The lake receives very little recreational use.

The Cabinet Face East IRA may also possess other roadless characteristics and values, such as high quality or undisturbed soil, water, and air; potential sources of public drinking water; diversity of plant and animal communities; habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land; reference landscapes; traditional cultural properties and sacred sites; and other locally identified unique characteristics. Other sections of this EIS, such as sections 3.18, *Soils and Reclamation* and 3.24, *Wildlife Resources*, describe these characteristics and values in the analysis area.

3.23.4 Environmental Consequences

3.23.4.1 Wilderness

3.23.4.1.1 Alternative 1 – No Mine

The CMW would not be directly affected by additional mine facilities. Sounds associated with existing activities at the Libby Adit Site would be audible within a small portion of the CMW in the upper Libby Creek drainage. Such activities on private land at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals. Noise levels in the CMW would return to low, ambient levels when reclamation was completed.

3.23.4.1.2 Alternative 2 – MMC Mine Proposal

All proposed surface disturbances and activities would occur outside the CMW boundary. The experience of wilderness visitors may be affected by mining-related activities outside the wilderness boundary. As discussed in section 3.16, *Scenery*, portions of the Montanore Project would be visible from at least one key viewpoint within the CMW at Elephant Peak. The Libby Adit Site, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment would potentially be visible from the CMW locations west of the facilities. The proposed Rock Lake Ventilation Adit, located adjacent to Rock Lake on a small parcel of private land within the CMW, would potentially be visible from within the CMW, although surface features at the ventilation portal would be minimal. Night lighting of the mine facilities would be visible from portions of the CMW west of the facilities. Areas cleared of timber for mine facilities would be visible from some locations within the CMW. The visual effects of mining operations would be noticeable during construction and operations and would diminish following facility reclamation and closure.

As discussed in section 3.19, *Sound, Electrical and Magnetic Fields, Radio and TV Effects*, noise from mining facilities would be higher than existing levels in the CMW. During construction, operation, and reclamation, noise from generators, fans, equipment, traffic, and plant operations would extend westward into the CMW, with about 55 dBA at the CMW boundary diminishing to about 30 dBA along the ridge between Elephant Peak and Eagle Peak. Following mine closure and reclamation, noise levels in the CMW would return to pre-mine levels. Elevated noise levels would occur periodically from traffic and monitoring activities following reclamation. Noise levels would return to pre-mine levels over the long term.

Because the wilderness experience is highly personal and individual, the perceived effect would differ among individuals. It is likely that the visual and noise effects of the project would reduce the natural quality of the wilderness experience for some individuals in portions of the wilderness. Visitation in the portions of the CMW exposed to sound and visual effects could decrease. Other qualities such as untrammeled, undeveloped, and outstanding opportunities for solitude or a primitive and unconfined type of recreation may also be diminished at some locations within the CMW for visitors while the project was in operation. These effects would occur throughout the duration of project operations and diminish following mining and reclamation.

3.23.4.1.3 Alternative 3 – Agency Mitigated Poorman Impoundment Site

Impacts to wilderness attributes and qualities would be similar to Alternative 2. Some mine facilities and roads would be visible from locations within the CMW. Noise levels in CMW would reach 30 dBA along the ridge between Elephant Peak and Ojibway Peak. Night lighting

also would be visible from portions of the CMW. In Alternatives 2 and 4, MMC would shield or baffle night lighting at all facilities, minimizing effects on night sky.

Effects to visual quality and increased levels of noise would diminish wilderness attributes for apparent naturalness, opportunities for solitude, and for primitive recreation of the wilderness experience from some locations in the CMW under Alternative 3. These effects would occur throughout the duration of project operations and diminish following mining and reclamation.

3.23.4.1.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Site

Impacts to wilderness attributes and qualities from the Plant and Adit sites would be the same as Alternative 3; the impoundment would have the same effects as Alternative 2. Some mine facilities and roads would be visible from certain viewpoints within the CMW. Noise levels would be similar to Alternative 3, and night lighting also would be visible from portions of the CMW. Effects to visual quality and increased levels of noise would diminish wilderness attributes for apparent naturalness, opportunities for solitude, and for primitive recreation of the wilderness experience from some locations in the CMW under Alternative 4.

3.23.4.1.5 Alternative A – No Transmission Line

In Alternative A, generators would be used to provide power to mine facilities. Noise levels in CMW would reach 30 dBA along the ridge between Elephant Peak and Ojibway Peak. Following mine closure and reclamation, noise levels in the CMW would return to pre-mine levels.

3.23.4.1.6 Effects Common to Alternatives B, C, D and E

None of the alternative transmission lines would encroach on CMW. Views from within the CMW would be affected by a new transmission line, particularly from high, open vistas such as Elephant Peak within the CMW. The visual effects of the transmission line alternatives from viewpoints within the CMW have been discussed in section 3.16, *Scenery*. None of the transmission line alternatives would affect wilderness attributes.

3.23.4.2 Inventoried Roadless Areas

3.23.4.2.1 Alternative 1 – No Mine

Alternative 1 would not directly affect the Cabinet Face East IRA. Sounds associated with the closure and reclamation of the Libby Adit Site would be audible within portions of the Cabinet Face East IRA in the Libby Creek drainage. Noise levels in the IRA would return to low, ambient levels when monitoring is completed.

3.23.4.2.2 Alternative 2 – MMC's Mine Proposal

Mine facilities in Alternative 2 would directly affect about 44 acres, or about 0.1 percent, of the Cabinet Face East IRA in the Ramsey Creek drainage. Timber harvest in the IRA would occur at the Ramsey Plant Site and a portion of LAD Area 1, and a road to the Ramsey Adits and LAD Area 1 would be built in the IRA. The Libby Adit Site, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment also would be visible from portions of the IRA. Night lighting at some mine facilities would be visible from the IRA. Roads and clearing areas may be visible from locations with high or open vantage points. Visual effects would be noticeable during construction and operations, and diminish following facility reclamation and closure. The visual effects of Alternative 2 have been discussed in section 3.16, *Scenery*. Sound levels between 30 and 45 dBAs would be audible for distances up to 1 mile from the eastern boundary of the IRA (Big Sky Acoustics 2006). Sound levels have been discussed in section 3.19, *Sound, Electrical*

and Magnetic Fields, Radio and TV Effects. The Cabinet Face East IRA boundary is segmented on the eastern edge by narrow corridors that exclude the roads in several drainages including Ramsey Creek (Figure 86). These narrow corridors will allow for some non-conforming uses adjacent to the IRA. The project would have no direct effect on Ramsey Lake, but would restrict access to it. The plant site would be located about 1,000 feet northeast of the lake. The noise level at Ramsey Lake would increase to about 55 dBA.

Natural Integrity and Appearance

Alternative 2 would not change the overall appearance of the Cabinet Face East IRA, but would affect the appearance of the IRA in locations nearest the direct impact. Changes in natural integrity and apparent naturalness would occur at the edges of the Cabinet Face East IRA in the Ramsey Creek drainage by the Ramsey Plant site and LAD Area 1.

Opportunities for Solitude

Proposed facilities in Ramsey Creek and Little Cherry Creek drainages also would reduce a person's opportunity for solitude on the east side of the Cabinet Face East IRA from Libby Creek watershed north to Bear Creek watershed because of the increased sound levels that would be generated by mine operations. Following mine closure and reclamation, noise levels and opportunities for solitude in the IRA would return to pre-mine conditions.

Primitive Recreation Opportunities

Views of the Libby Adit Site, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment from high or open locations in the IRA may affect some visitors' primitive recreational experience. Alternative 2 would eliminate access to portions of the Ramsey Creek drainage beyond LAD Area 1, eliminating recreational opportunities in those portions of the IRA. Access to Poorman Creek also would be restricted under Alternative 2. The access restriction would continue for the life of the project. Due to the restricted access and noise levels, visitors to the area also would likely no longer make Ramsey Lake a destination under this alternative during the project's life. Primitive recreation opportunities would not be affected in the rest of the roadless area. Primitive recreation opportunities would return to pre-mine levels after mine closure and reclamation.

Special Features

Access to Ramsey Lake would be restricted and noise levels would be high enough to deter visitation during the life of the project.

Manageability and Boundaries

The IRA affected by the Ramsey Plant Site and LAD Area 1 in the Ramsey Creek drainage would potentially prevent the establishment of a future wilderness boundary in Ramsey Creek. Manageability and boundaries would return to pre-mine conditions after mine closure and reclamation.

3.23.4.2.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would avoid direct impacts to the IRA west of LAD Area 1 and at the Ramsey Plant Site. No road construction or timber harvest would occur in the IRA. Increased noise levels from the Libby Plant Site would be audible from within the IRA between Libby and Ramsey creeks. Similar noise levels would be audible from within the IRA west of LAD Area 1. Adverse visual

impacts from within the IRA would be similar to Alternative 2. IRA attributes would return to pre-mine conditions after mine closure and reclamation.

3.23.4.2.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Effects on the IRA would be similar to Alternative 3 due to similar positioning of the facilities in and near Libby Creek. No road construction or timber harvest would occur in the IRA. Visual impacts from within the IRA would be similar to Alternative 2.

3.23.4.2.5 Alternative A – No Transmission Line

In Alternative A, generators would be used to provide power to mine facilities. Increased noise levels from the Libby Plant Site would be audible from within the IRA between Libby and Ramsey creeks. IRA attributes would return to pre-mine conditions after mine closure and reclamation.

3.23.4.2.6 Alternative B MMC's Proposed Transmission Line (North Miller Creek Alternative)

MMC's proposed North Miller Creek transmission line alignment would physically disturb about 2 acres of the Cabinet Face East IRA in the Ramsey Creek drainage. Timber harvest for line clearing would occur in the IRA. The small area disturbed in the IRA would not directly affect the primitive recreation opportunities and other features, opportunities for solitude, roadless area manageability and boundaries, or special features and special values. The steel monopoles, new roads and associated timber harvest, which would be required under Alternative B, would parallel the IRA boundary along most of Ramsey Creek, and would be visible from some viewpoints within the IRA, particularly high, open vistas. These views also may contribute to a loss of opportunities for solitude for some visitors to the IRA. The visual effects of the transmission line alternatives from some viewpoints within the IRA have been discussed in section 3.16, *Scenery*. Noise from transmission line construction would be audible in the IRA adjacent to Ramsey Creek. IRA attributes would return to pre-transmission line conditions after transmission line decommissioning.

3.23.4.2.7 Effects Common to Alternatives C, D, and E

The other three transmission line alternatives would avoid physical disturbance in the Cabinet Face East IRA. No road construction or timber harvest would occur in the IRA. Transmission line construction to the Libby Plant Site would be audible in the IRA between Libby and Ramsey creeks. Views from the IRA would be affected by new H-frame transmission lines, particularly from high, open vistas. The visual effects of the transmission line alternatives from some viewpoints within the IRA have been discussed in section 3.16, *Scenery*. IRA attributes would return to pre-transmission line conditions after transmission line decommissioning.

3.23.4.3 Cumulative Effects

Past actions have not substantially altered the attributes of the CMW or the Cabinet Face East IRA. The existing Libby Adit is visible from some locations in the CMW and the Cabinet Face East IRA. Development of the reasonably foreseeable Rock Creek Project likely would have similar effects on wilderness and roadless areas as those described for development of the Montanore Project. The Rock Creek Project would not be visible from key viewpoints identified for the Montanore Project scenery analysis. Other viewpoints within the CMW would be affected by the Rock Creek Project. The Snowshoe Mine and Snowshoe Creek CERCLA Project, which would remove tailings from the Snowshoe Mine Site, would occur adjacent to the CMW and IRA

boundaries (Maxim 2004). Noise from this activity in combination with the Montanore Project may have an effect on wilderness and IRA visitors. Wilderness visitors at some locations also may be affected by the clearing of timber for any of these future project facilities. The cumulative effects of the Rock Creek Project, the Snowshoe Project, and the Montanore Project might contribute to a loss of wilderness attributes desired by some individuals.

The Rock Creek Project would not affect the Cabinet Face East IRA and would not contribute to the cumulative effects on Cabinet Face East IRA. Libby Creek Ventures plans to drill three boring holes in the Libby Creek drainage outside of the Cabinet Face East IRA, which may increase activity and noise in the drainage and in nearby parts of the IRA for up to one week. About 1 acre of land is planned for clearing. This activity in combination with the Montanore Project may have a short-term adverse cumulative effect upon visitors to the IRA and the CMW.

3.23.4.4 Regulatory/Forest Plan Consistency

None of the mine and transmission line alternatives would physically disturb any lands within the CMW. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not regulate activities outside the wilderness. Consequently, all mine and transmission line alternatives would be in compliance with the KFP regarding the CMW.

Mine Alternative 2 and transmission line Alternative B would require road construction and timber harvest within the Cabinet Face East IRA. MMC has valid existing rights to access the minerals proposed for mining with the Montanore Project, and road construction and timber harvest in the Cabinet Face East IRA are necessary for the development of those rights. The other mine and transmission line alternatives would not require road construction and timber harvest within the Cabinet Face East IRA. The experience of IRA visitors might be affected by activities outside the IRA boundary.

3.23.4.5 Irreversible and Irretrievable Commitments

None of the alternatives would result in an irreversible and irretrievable commitment of resources within the CMW. Wilderness experiences for some visitors may be irretrievably affected from specific viewpoints within the CMW under any of the alternatives. Alternative 2 and MMC's proposed North Miller Creek transmission line alternative would irretrievably devote small portions of the Cabinet Face East IRA to mining uses over the life of the project. Roadless area attributes would be irretrievably affected in the Ramsey Creek drainage under Alternative 2.

3.23.4.6 Short-term Uses and Long-term Productivity

In the short term, development of the project under Alternative 2 would affect the consideration of a small portion of the Cabinet Face East IRA in the Ramsey Creek drainage for permanent designation as wilderness during the project's life due to the project facilities' direct disturbance of the IRA. In the long term, areas that were cleared of timber for facilities would be visible from a number of key viewpoints, both in the CMW and the Cabinet Face East IRA, resulting a long-term impact to the visual quality of some visitor's experience.

3.23.4.7 Unavoidable Adverse Environmental Effects

Under Alternative 2, noise levels would be increased from the Ramsey Plant Site up to the ridge between Elephant Peak and Eagle Peak in the CMW. Under Alternatives 3 and 4, noise levels

would increase from the Libby Plant Site up to the ridge between Elephant Peak and Ojibway Peak. Under all alternatives, night lighting would be visible from some locations of the CMW. Therefore, all mine and transmission line action alternatives would reduce the opportunities for solitude in both the CMW and the Cabinet Mountains East IRA. Wilderness natural qualities in certain areas also would be affected under all action alternatives. Under Alternative 2, primitive recreation opportunities would no longer exist in the Ramsey Creek drainage within the IRA due to the unavoidable physical impacts, presence of facilities, increased noise levels, and night lighting.

3.24 Wildlife Resources

3.24.1 Introduction

The KNF area contains habitat for more than 300 different species of wildlife (USDA Forest Service 2003c), many of which occur on the Libby Ranger District (District) and within the Montanore Project analysis area. The Forest Service and the FWP work together to ensure that an appropriate balance is maintained between habitat capability and population numbers. The Forest Service also works closely with the USFWS to assist in the recovery of animals listed under the ESA. Proposed federal actions that have the potential to impact species protected by the ESA require consultation with the USFWS.

Wildlife resources selected for detailed analysis represent a combination of fine filter (species-specific) and coarse filter (management indicator species) analyses. The USFWS requires endangered, threatened, and proposed species be included in an effects analysis. Any effects to Forest Service-sensitive species, which are designated by the Regional Forester, also are disclosed. The evaluation of impacts to Montana Species of Concern is part of the Major Facility Siting Act (MFSA) transmission line certification process. Management Indicator Species (MIS) are identified in the KFP and represent a particular habitat or habitat complex. Each MIS represents a group of species that share common habitat components required for sustained growth and successful reproduction. This section is comprised of six subsections: key habitats, MIS, Forest Service sensitive species, federal threatened and endangered species, migratory birds, and other species of interest, namely moose and Montana Species of Concern.

The analysis area for each species was determined based on viability analysis concepts described by Ruggiero *et al.* (1994), which take into consideration biological populations and ecological scale. Evaluation of species viability is based on concepts and direction provided in the forest-wide conservation plan (Johnson 2004a). The KNF is comprised of eight planning units, which are geographic areas based on sub-basins. Each planning unit contains several Planning Subunits (PSUs), which are management areas generally based on watersheds. With the exception of threatened and endangered species, unless otherwise indicated, the analysis area for National Forest System lands consists of the PSUs potentially affected by the project. The analysis area is the Crazy and Silverfish PSUs (Figure 87). The eastern segments of the transmission line alternatives are located on private land (Figure 77). Potential impacts to wildlife resources on private land are evaluated qualitatively and are not included in most habitat calculations conducted to assess compliance with numeric standards, objectives, and guidelines in the KFP. Assessment of effects on private land is discussed in each subsection. Cumulative effects for most wildlife resources are analyzed for the KNF and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. Analysis areas for threatened and endangered species are based on management areas defined in recovery plans and any additional non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The wildlife analysis includes a description of existing conditions (the affected environment created by all past and current management practices and natural events), and direct, indirect, and cumulative effects of the project alternatives.

3.24.2 Key Habitats

Key habitats play a particularly important role in the survival and success of the most vulnerable wildlife species. While some species can be found in a variety of habitats, many are less adaptive and are restricted to more limited habitats. This section describes the characteristics and importance of cavity habitat provided by snags and woody debris. Old growth forests, riparian areas, and wetlands, which are also key habitats, have been discussed in sections 3.21, *Vegetation* and 3.22, *Wetlands and Other Waters of the U.S.* Effects on wildlife species associated with cavity habitat are evaluated in the pileated woodpecker analysis discussed in section 3.24.3, *Management Indicator Species*.

3.24.2.1 Regulatory Framework

The KFP establishes forest-wide objectives, standards, guidelines, and monitoring requirements for cavity habitat. Recommendations for down wood are described in the Fisher Landscape Assessment (USDA Forest Service 2003d) and are incorporated by reference. According to KFP guidelines (USDA Forest Service 1987), to maintain viable populations of primary excavators, commercial forest lands should include at least 0.9 snags per acre (40 percent of the estimated maximum potential cavity-nester population level, or PPL) and riparian areas should include a minimum of 1.35 snags per acre (60 percent of the PPL). For down wood, current KFP guidelines are to leave 5 to 15 tons of large (greater than 12 inches diameter) down wood per acre.

The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives. FWP is required to report DEQ information relating to the impact of the proposed site on FWP's area of expertise. The report may include opinions as to the advisability of granting, denying, or modifying the certificate.

3.24.2.2 Snags and Woody Debris

3.24.2.2.1 Analysis Area and Methods

The analysis area for direct and indirect impacts on habitat provided by snags and down wood in the KNF includes the Crazy and Silverfish PSUs. PSUs are sufficiently large to cover home range sizes of species associated with snag and down wood habitat structure. To evaluate potential direct and indirect impacts of the transmission line on cavity habitat on private and state land, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. The cumulative effects analysis area for cavity habitat is comprised of the Crazy and Silverfish PSUs and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

Because KFP standards for riparian habitat, as amended by the INFS, ensure the 60 percent cavity nester PPL (potential population level) standard for riparian areas in the KNF, the following analysis focuses on the general forest standard of 40 percent PPL. The effects indicators for snag and down wood habitat in the KNF are: 1) percent of the estimated maximum cavity-nester population by PSU; and 2) acres of snag and down wood habitat removed.

The percent of the PPL was estimated based on Thomas (1979). The percent PPL was calculated by multiplying the snag level percent by the percent of area with that snag level (ibid.). Snag levels were derived from field data based on the following conservative approach:

- Old growth and untreated forest stands provide 2.5 snags per acre, which is considered 100 percent snag level (Tincher 1998).
- Partial cut stands provide 1.35 snags per acre, or at least 60 percent snag level (Johnson and Lamb 1998).
- Regeneration (harvested) units provide 0 to 80 percent snag level, depending on period of harvest. Units harvested prior to the KFP, and those planned prior to 1987 but harvested through 1992, essentially provide no cavity habitat and have a snag level of 0 (Johnson and Lamb 1998), unless site-specific data shows otherwise. Units harvested after the 1987 KFP (1993-2002) provide at least 40 percent snag level, or 0.9 snags per acre (USDA Forest Service 2003b).
- Roads provide 0 percent snag level. Roads account for 4 acres per mile of disturbance (average 33 feet wide times 5,280 feet per mile divided by 43,560 square feet per acre).
- Snag densities adjacent to open roads are the same as snag densities adjacent to closed roads (Bate and Wisdom 2004). While some snags are lost due to firewood cutting, according to Tincher (1998), snag levels within 200 feet of open roads range from 40 to 80 percent. Snag densities have been shown to decrease with proximity to towns (Bate and Wisdom 2004), and forest-wide, visual observations suggest that snag levels adjacent to roads can be as low as zero. Because firewood cutting is allowed from any open road, retention of snags within 200 feet of the road over time is highly unlikely. Thus, a worst-case scenario, or total snag loss, was assumed within 200 feet on each side of a road. This results in zero snag potential on an additional 49 acres per mile of road (400-foot buffer total width x 5,280 feet per mile divided by 43,560 square feet/acre – rounded to next whole acre).

For the Crazy PSU, data sources for snag and down wood habitat include District surveys for old growth and harvested units. Surveys for downed wood and snags are included as part of old growth surveys. Old growth survey methods are described in section 3.21, *Vegetation*. A description of the survey procedure used for existing harvest units is available in the KNF project record. Snag surveys in both old growth and harvested stands in the Crazy PSU cover about 7,502 acres. These surveys recorded snags in diameter classes based on wildlife habitat needs. Data was collected on coarse wood material more than 10 inches in diameter.

Site-specific snag and down wood survey data for the Silverfish PSU is incomplete. Information from the TSMRS was used to estimate snag densities for the Silverfish PSU. Details regarding TSMRS are available in the District files.

The analysis area includes private and state lands crossed by the eastern segments of the alternatives transmission line alignments (Figure 77). Quantitative snag and down wood information is not available for private or state-owned lands in the analysis area, much of which has been logged in the past 20 to 30 years. Current snag and down wood availability on private land was estimated based on vegetation mapping shown on Figure 83 and likely past and current land use practices.

3.24.2.2.2 Affected Environment

Snags, broken topped live trees, live cull trees, and down logs are used by a great variety of wildlife species for nesting, denning, perching, roosting, feeding, and shelter. On the KNF, 42 species of birds, 14 species of mammals, and several species of amphibians are recognized as

largely dependent on cavity habitat (snags and down wood). Table 152 summarizes the existing cavity habitat potential on National Forest System lands in the Crazy and Silverfish PSUs. The following discussion describes existing conditions relative to KFP objectives and guidelines, and a similar analysis was not done for private lands.

Table 152. Existing PPL on National Forest System lands in the Crazy and Silverfish PSUs.

Habitat Component	Acres	Percent of PSU	Total Snags per Acre	Snags per Acre at Managed Snag Level[1]	Snag Level[2] (%)	Potential Population Level (%)[2]
Crazy PSU						
Old growth surveyed for snags[3]	6,157	10	3.83	2.25	100	10
Remaining old growth and untreated forest	30,162	50	No site-specific data	2.25	100	50
Units harvested from 1985 – 1997[3]	1,345	2	3.25	0.9	100	2
Past Regen. Harvest (1997 – present)[4]	577	<1	No site-specific data	0.9	40	<1
Partial Cut Forest[5]	5,806	10	No site-specific data	1.35	60	6
Roads and buffer (53 acres per mile)[6]	15,103	25	N/A	0.0	0	0
Non-forest Habitat[7]	1,065	2	N/A	0.0	0	0
Total Forest Lands in Crazy PSU	60,215	100	N/A	N/A	N/A	69
Silverfish PSU						
Old Growth and Untreated Forest	40,782	67	No site-specific data	2.25	100	67
Past Regen. Harvest (1993 – present)[4]	522	1	No site-specific data	0.90	40	<1
Past Regen. Harvest Prior to 1993)[4]	3,449	6	No site-specific data	0.00	0	0
Partial Cut Forest[5]	5,629	9	No site-specific data	1.35	60	6
Roads and buffer (53 acres per mile)[6]	10,139	17	N/A	0.00	0	0
Non-forest Habitat[7]	0	0	N/A	0.00	0	0
Total Forest Lands in Silverfish PSU	60,521	100	N/A	N/A	N/A	73

See footnotes on next page.

N/A = not applicable
[1] The managed snag level is the number of snags per unit of area >10" diameter at breast height (dbh) selected as a management goal, based on values from Thomas 1979, Tincher 1998, Johnson and Lamb 1998, Bate and Wisdom 2004, and KNF forest-wide observations for worst-case scenario.
[2] Percent of sub-unit (expressed as decimal) times snag level percent equals proportionate PPL for each habitat component. The sum of proportionate PPLs from all habitat components is the PPL for the PSU (Thomas 1979). If actual snags per acre (Crazy PSU only) are equal to or greater than snags per acre at the managed snag level, then managed snag level applies. For the Silverfish PSU, managed snag level is used.
[3] District snag survey data for the Crazy PSU. Includes all snags >10" dbh. For the Silverfish PSU, PSU-specific data are not available.
[4] Regeneration harvest from TSMRS database and includes activity codes: 4100 thru 4149. Snags per acre and snag level based on Johnson and Lamb 1998.
[5] Partial cut forest data from TSMRS database and includes activity codes: 4150 thru 4241. Snags per acre and snag level based on Johnson and Lamb 1998.
[6] Snags per acre and snag level based on Tincher 1998, Bate and Wisdom 2004, and KNF forest-wide observations for worst-case scenario.
[7] Based on KNF GIS data layers for the following Vegetative Response Units: Grassland Steppe, Mountain Bottomlands, Agricultural Lands, Rural/Urban, Rock/Scree/Ice, and Water.
Source: GIS analysis by ERO Resources Corp. using KNF data.

The existing PPL on National Forest System lands in the Crazy PSU is 69 percent, while the PPL on National Forest System lands in the Silverfish PSU is 73 percent (Table 152). The PPL for both PSUs are greater than the 40 percent PPL recommended in the KFP. According to the 1997 KFP Monitoring Report (USDA Forest Service 1998b), KNF cavity excavator PPL was 88.7 percent. The 2002 report (USDA Forest Service 2003c) indicates that 95 percent of the compartments monitored meet or exceed KFP standards for PPL, the 40 percent PPL is being met in the KNF, and the KNF is providing sufficient cavity habitat at the drainage or compartment scale as well as the forest scale. KFP riparian standards, as amended by INFS, ensure the 60 percent level is being met in those areas.

Historically, wildfires have played a large role in the amount of down wood in the forests (Graham *et al.* 1994). Depending on the frequency, intensity, and magnitude of fires, ponderosa pine forests could have more than 45 tons per acre of down wood while western white pine forests could have more than 268 tons per acre of down wood. The longer period of time between fires, the longer the down wood would remain. During the last 100 years, the frequency of fires in the northern Rocky Mountains has been greatly reduced, potentially resulting in larger amounts of down wood. Results of surveys of down wood in the Crazy PSU and portions of the Silverfish PSU shown in Table 153 suggest that KNF guidelines of 5 to 15 tons of down wood per acre are being met in old growth and past harvest areas.

Table 153. Down Wood Greater than 10 inches in Diameter in the Crazy and Silverfish PSUs.

PSU	Down Wood Survey Sites	Acres Surveyed	Tons/Acre (average)*
Crazy	Old growth	6,157	31
Crazy	Past timber harvest units	2,569	41
Silverfish	Old growth	2,404	23
Silverfish	Past timber harvest units	Data not available	Data not available

*Current KFP guidelines are to leave 5 to 15 tons of large (greater than 12" diameter) down wood per acre.
Source: KNF District files.

Because downed wood material in the 3 to 9 inch range was not tallied, the total tonnage was likely underestimated. Tonnage also varied considerably in the past harvest units. This was likely due to site preparation methods used after timber harvest, and the number of snags and standing trees left after harvest, which could eventually be recruited to the forest floor.

Although data are incomplete for the Silverfish PSU, the KFP directs that sufficient amounts of large downed wood material be retained on-site for wildlife habitat needs, nutrient release back into the soil, and site protection for timber stand regeneration. The current KFP direction (KFP Vol. 2, A16-6) is to meet timber/silviculture guideline #9, which is to leave logs greater than 12-inch diameter scattered through out harvest units (a few pieces per acre). Five to 15 tons per acre is recommended. Current management activities in the Silverfish PSU are designed to meet guideline #9.

The majority of the non-National Forest System lands in the analysis area is heavily roaded and has been logged in the past 20 to 30 years (Figure 83), and it is not likely that snags have been left standing. As a result, snag and down wood is likely to be less available on private and state lands.

3.24.2.2.3 Environmental Consequences

Impacts to snag habitat and changes in PPL from the various project features of the mine and transmission line alternatives are shown in Table 154 and Table 155, and described in the following subsections.

Table 154. Impacts on Snag Habitat and Potential Population Level in the KNF by Mine Alternative.

Activity	[1] No Mine/Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative	[4] Agency Mitigated Little Cherry Creek Impoundment Alternative
Facility Construction (Tailings Impoundment, Plant Site, and Other Facilities) (acres)	0	1,605	1,044	1,151
Road Construction and Improvement (acres)	0	108	100	99
Total Disturbance Impacts (acres)	0	1,713	1,144	1,250
Percent Potential Population Level				
Crazy PSU (percent)	69 (0)	66 (-3)	67 (-2)	67 (-2)
Silverfish PSU (percent)	73 (0)	73 (0)	73 (0)	73 (0)

Number in parentheses is percent change from [1] No Mine/Existing Conditions.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 155. Impacts on Snag Habitat and Potential Population Level in the KNF by Transmission Line Alternative.

Activity	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
Road Construction and Improvement (acres)	0	87	51	63	63
Transmission Line Clearing and Construction (acres)	0	70	91	96	170
Total Disturbance Impacts (acres)	0	157	142	159	233
Percent Potential Population Level					
Crazy PSU (percent)	69 (0)	68 (-1)	69 (<-1)	69 (<-1)	69 (<-1)
Silverfish PSU (percent)	73 (0)	72 (-1)	73 (<-1)	73 (<-1)	72 (-1)

Number in parentheses is percent change (+/-) due to alternative.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 1 – No Mine

In Alternative 1, no disturbance and no direct impacts on snags would occur. Cavity habitat would be available at current levels for wildlife use. The addition or loss of snags would depend on other factors, such as firewood cutting, wind events, natural attrition, or wildfire. The level of impact from these factors cannot be calculated due to the high uncertainty in predicting occurrence and intensity levels. This alternative would not change the current condition or availability of down wood within the PSU.

Alternative 2 – MMC Proposed Mine

Snags and down wood would be cleared within most of the disturbance boundaries for Alternative 2. Alternative 2 would result in the disturbance of 1,713 acres due to facility and road construction. Most disturbance would occur on National Forest System lands, although some private land would be disturbed (Figure 77). Surface disturbance associated with Alternative 2 would result in a long-term (125 to 150 years), site-specific reduction in suitable cavity habitat for species (*e.g.*, pileated woodpeckers) that do not nest in open areas. About 1,350 acres would be cleared for the tailings impoundment and associated components, which would likely encompass the entire home range territories of many cavity-nesting species. In the long term, some reclaimed

areas would provide cavity-nesting habitat as the forest matured. Implementation of MMC's proposed Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*) would ensure that impacts to snag habitat in riparian areas on National Forest System lands would be minimized.

At the PSU scale, Alternative 2 would result in a 3 percent decrease in PPL in the Crazy PSU; the PSU would remain greater than the 40 percent level recommended in the KFP. Alternative 2 would have no effects on snag habitat in the Silverfish PSU. Based on available data (Table 153), existing levels of down wood in the Crazy PSU are greater than KFP guideline levels; Alternative 2 would cause the loss of all down wood on 1,713 acres. Based on the available data for existing conditions (Table 153), adequate down wood habitat would remain available in the Crazy PSU.

Alternative 2 would result in noise and other disturbances associated with blasting, construction of the plant and adit sites, road construction and use, and plant and adit operations that could deter some wildlife from using nearby snags and down wood. Disturbance impacts would likely be greatest during the construction phase, but may persist through mine operations. Impacts of human-caused disturbance from Alternative 2 on species associated with snag and down wood habitat structure for the pileated woodpecker are described in section 3.24.3, *Management Indicator Species*.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to snag and down wood habitat from Alternative 3 would be similar to Alternative 2 except that there would be less surface disturbance and a smaller decrease in PPL. Alternative 3 would result in the disturbance of 1,144 acres due to facility and road construction and would result in a 2 percent decrease in PPL. About 927 acres would be cleared for the tailings impoundment and associated components, which would likely encompass the entire home range territories of many cavity-nesting species.

Similar to Alternative 2, implementation of the agencies' Wetland Mitigation Plan (see section 2.5.7.1, *Wetland Mitigation*) would ensure that impacts to snag habitat in riparian areas on National Forest System lands would be minimized. KNF riparian standards and guidelines, as amended by the INFS, would ensure that impacts to snag habitat in riparian areas on National Forest System lands would be minimized. Impacts to snag and down wood habitat on National Forest System land and private land also would be minimized in Alternative 3 through implementation of the Vegetation Removal and Disposition Plan developed for agencies' alternatives discussed in section 2.5.3.2.1, *Vegetation Removal and Disposition*.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Relative to the other mine alternatives, Alternative 4 would affect snag habitat less than other mine alternatives. The impacts to snag and down wood habitat from Alternative 4 would be the same as Alternative 3, except that there would be less surface disturbance. Alternative 4 would result in the disturbance of 1,250 acres of National Forest System land due to facility and road construction. About 1,034 acres would be cleared for the tailings impoundment and associated components, which would likely encompass the entire home range territories of many cavity nesting species.

Alternative A – No Transmission Line

In Alternative A, no disturbance and no direct impacts on snags would occur. The addition or loss of snags would be dependent on other factors, such as firewood cutting, wind events, natural

attrition, or wildfire. Alternative A would not change the current condition or availability of down wood within the PSU.

Alternative B – MMC Proposed Transmission Line

Alternative B would result in the disturbance of 157 acres due to facility and road construction. About 129 acres of disturbance would occur on private land (Figure 77). The majority of the private land that would be disturbed by Alternative B is heavily roaded and has been logged in the past 20 to 30 years, and likely provides less snag and down wood habitat than National Forest System lands. Vegetation would be cleared from access roads, pulling and tensioning sites, and within the transmission line clearing area. Surface disturbance would result in a long-term (125 to 150 years), site-specific reduction in suitable cavity habitat for species (*e.g.*, pileated woodpeckers) that do not nest in open areas. In the long term, some reclaimed areas would provide cavity-nesting habitat as the forest matured. Portions of the clearing area would not require clearing, such as high spans across valleys, and trees would be maintained in these areas. New roads would not be open to the public, would undergo interim reclamation after construction, and would be bladed and recontoured to match existing topography at mine closure; therefore, areas adjacent to new roads would not likely reduce snag levels from firewood gathering.

At the PSU scale, snag levels in Alternative B would decrease by 1 percent in the Crazy and Silverfish PSUs, but would remain greater than the 40 percent recommended in the KFP. Based on available data (Table 153), existing levels of down wood in the Crazy and Silverfish PSUs appear to be greater than KFP guideline levels; Alternative B would likely have minimal impacts on the availability of down wood in either PSU.

Impacts to snag and down wood habitat on KNF, state, and private land would be minimized through implementation of the Environmental Specifications (Appendix D). Implementation of KNF riparian standards and guidelines, as amended by the INFS (USDA Forest Service 1995), and the Environmental Specifications also would ensure that impacts to snag habitat in riparian areas would be minimized.

Alternative B would result in noise from helicopters during line stringing that may temporarily deter some wildlife from using nearby snags and down wood. Similar effects would occur from other transmission line construction activities where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and, with the exception of line inspection and maintenance activities, would cease after transmission line construction until decommissioning. Helicopter use and other construction activities would cause similar disturbances with similar durations during line decommissioning. Impacts of human-caused disturbance from Alternative B on species associated with snag and down wood habitat structure for the pileated woodpecker are described in section 3.24.3, *Management Indicator Species*.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to snags and down wood for Alternative C would be the same as Alternative B, except that there would be less surface disturbance and a smaller decrease in PPL, helicopter disturbance during construction could last up to 2 months longer where helicopters were used for clearing and line construction, and construction activities where helicopters are not used would be less extensive. Alternative C would result in the disturbance of 142 acres due to road construction and

transmission line clearing, while the PPL in the Crazy and Silverfish PSUs would not be measurably affected.

Impacts of Alternative C on snag and down wood habitat on KNF and private land would be minimized through implementation of the Wetland Mitigation Plan, the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) developed for agencies' alternatives, and the Environmental Specifications (Appendix D).

Alternative D – Miller Creek Transmission Line Alternative

Impacts to snags and down wood for Alternative D would be the same as Alternative C, except that there would be slightly more surface disturbance. Alternative D would result in the disturbance of 159 acres due to road construction and transmission line clearing.

Alternative E – West Fisher Creek Transmission Line Alternative

Relative to the other transmission line alternatives, Alternative E would affect snag habitat the most. The impacts to snag and down wood habitat from Alternative E would be the same as Alternative D, except that there would be more surface disturbance and a larger decrease in PPL in the Silverfish PSU. Alternative E would result in the disturbance of 233 acres due to facility and road construction and would result in a 1 percent decrease in PPL in the Silverfish PSU.

Combined Mine-Transmission Line Effects

Impacts from combined mine-transmission line alternatives on snag and down wood habitat are shown in Table 156.

Relative to other action alternatives, combined Alternative 2B would result in the greatest impacts on the availability of snags and down wood, directly disturbing 1,870 acres, and resulting in a 5 percent decrease in PPL for the Crazy PSU, and a 1 percent decrease in PPL for the Silverfish PSU. Snag habitat cleared for the tailings impoundment and associated components would range between 927 acres for Alternatives 3C, 3D, and 3E and 1,351 acres for Alternatives 2B, 2C, and 2D. In all alternatives, the area impacted by the construction of the tailings impoundment would likely encompass the entire home range territories of many different cavity-nesting species. Combined Alternative 3C would have the least impacts on cavity habitat, resulting in 1,286 acres of habitat disturbance. All of the combined agencies' alternatives would result in a 3 percent decrease in the PPL in the Crazy PSU and would not measurably change the PPL in the Silverfish PSU. In all combined action alternatives, the PPL would remain greater than the 40 percent recommended in the KFP, and it is likely that down wood would continue to be available at levels greater than recommended in the KFP.

The majority of the private land that would be disturbed by the combined action alternatives is heavily roaded and has been logged in the past 20 to 30 years, and likely provides more limited snag and down wood habitat than National Forest System lands. Vegetation would be cleared from access roads, pulling and tensioning sites, and within the transmission line clearing area. Surface disturbance would result in a long-term (125 to 150 years), site-specific reduction in suitable cavity habitat for species (*e.g.*, pileated woodpeckers) that do not nest in open areas. In the long term, some reclaimed areas would provide cavity-nesting habitat as the forest matured. Portions of the clearing area would not require clearing, such as high spans across valleys, and trees would be maintained in these areas. New roads would not be open to the public; therefore, areas adjacent to new roads would not likely have reduced snag levels from firewood gathering.

Table 156. Impacts on Snag Habitat and Potential Population Level in the KNF by Combined Mine-Transmission Line Alternative.

Activity	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Facility Construction (Tailings Impoundment, Plant Site, and Other Facilities) (acres)	0	1,605	1,044	1,044	1,044	1,151	1,151	1,151
Road Construction and Improvement (acres)	0	195	151	163	163	150	162	162
Transmission Line Clearing and Construction (acres)	0	70	91	96	170	91	96	170
Total Disturbance Impacts* (acres)	0	1,870	1,286	1,303	1.377	1,392	1,409	1,483
Percent Potential Population Level (PPL)								
Crazy PSU (percent)	69	64 (-5)	66 (-3)	66 (-3)	66 (-3)	66 (-3)	66 (-3)	66 (-3)
Silverfish PSU (percent)	73	72 (-1)	73 (0)	73 (0)	72 (-1)	73 (0)	73 (0)	72 (-1)

TL = Transmission Line Alternative.
Number in parentheses is percent change (+/-) due to Alternative.
*May be slightly greater than actual impacts due to areas of overlap between mine and transmission line disturbance areas.
Relative total disturbance impacts of different alternatives may differ from relative PPLs due to the distribution of disturbance between the Crazy and Silverfish PSUs.
Source: GIS analysis by ERO Resources Corp. using KNF data.

In all combined action alternatives, impacts to snag and down wood habitat on National Forest System, state, and private land would be minimized through implementation of MMC's or the agencies' Wetland Mitigation Plan (see sections 2.4.6.1 and 2.5.7.1, *Wetland Mitigation*) and the Environmental Specifications (Appendix D). Implementation of KNF riparian standards and guidelines, as amended by the INFS, and the Environmental Specifications also would ensure that impacts to snag habitat in riparian areas would be minimized. Impacts to snag and down wood habitat on National Forest System and private land also would be minimized in the combined agencies' alternatives through implementation of the Vegetation Removal and Disposition Plan discussed in section 2.5.3.2.1, *Vegetation Removal and Disposition*.

All combined action alternatives would result in noise and other human-caused disturbances from activities associated with blasting, construction of the plant and adit sites, road construction and use, plant and adit operations, and helicopter use. Disturbance from helicopter use and other transmission line construction activities are described above for Alternatives B and C. Disturbance impacts would likely be greatest during the construction phase, but could persist through mine operations.

Cumulative Effects

Past actions, particularly timber harvest, road construction, fire suppression, and firewood gathering activities, have contributed to a reduction in large snags and down wood (USDA Forest Service 2003b). Firewood cutting and gathering would continue to occur where open roads provided access to forest habitat, contributing to snag and down wood removal. Continuing development of private lands, including timber harvest, home construction, and land clearing, would contribute to losses of cavity habitat in the analysis area. The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. Timber harvest and other clearing activities planned for the Miller-West Fisher Vegetation Management Project would contribute to cumulative losses of snags and down wood in the Silverfish PSU. Activities associated with the Miller-West Fisher Vegetation Management Project are expected to retain cavity habitat within KFP-recommended levels for the Silverfish PSU. Also, while prescribed burns associated with the Miller-West Fisher Vegetation Management Project would consume some snags and down wood, it also would create snags and down wood by killing live trees. Snags and down wood created in burned areas would provide both feeding and nesting habitat for cavity-nesting birds such as the pileated woodpecker. Other reasonably foreseeable actions would involve minimal disturbance to snags and down wood.

The No Action alternatives (Alternatives 1 and A) would not contribute to cumulative losses of snags and down wood, and would not contribute to cumulative effects on cavity-nesting habitat. In combination with other reasonably foreseeable actions, the mine and transmission line action alternatives would likely result in cumulative reductions in PPL in the analysis area. Given the current levels of snags and down wood, and the overall surface area that would be impacted, it is likely in all action alternatives that the resulting PPL would remain greater than the KNF-recommended minimum level, and that sufficient cavity habitat to maintain viable populations of cavity nesters would remain in the KNF. While the action alternatives would contribute to losses of snag and down wood on private and state lands, the quality of habitat for cavity-nesters is likely relatively low in these areas due to past and current land use practices.

3.24.2.2.4 Regulatory/Forest Plan Consistency

None of the alternatives would change the PPL below the KFP-recommended levels in either the Silverfish or Crazy PSU. In all alternatives, the KFP cavity habitat standard (40 percent PPL) in MAs 11, 12, and 14-18 would be met. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. The requirement to retain habitat in MA 10 would continue to be met because none of the disturbance associated with the action alternatives would occur in MA 10.

Given the current amounts of down wood available in the analysis area, it is likely that in all action alternatives, down wood would continue to be available in quantities recommended in the KFP. For all alternatives KFP direction for snags and down wood would continue to be met and would contribute to the viability of associated species.

3.24.2.3 Irreversible and Irretrievable Commitments

All action alternatives would result in an irreversible commitment of cavity habitat provided by snags and down wood in the analysis area. Recruitment of snags and down wood would not occur until forest communities re-established and matured, a process that would likely require more than 100 years following disturbance.

Noise, dust, and the presence of humans and machinery associated with the action alternatives could cause some cavity-nesters to avoid nearby habitat, resulting in irretrievable commitments of cavity habitat.

3.24.2.4 Short-term Uses and Long-term Productivity

Losses of snags and down wood resulting from the action alternatives would be long-term, lasting beyond the reclamation phase. If reclamation were successful, snag and down wood densities could be restored to pre-project levels, but only after a considerable length of time.

3.24.2.5 Unavoidable Adverse Environmental Effects

Unavoidable adverse environmental effects would occur from all action alternatives in the analysis area where snags and down wood would be directly removed and where cavity nesters would avoid nearby habitat.

3.24.3 Management Indicator Species

As specified in the KFP, MIS may serve as surrogates for species with similar breeding and foraging habitat requirements, providing a tool for more accurately monitoring more than 300 different species of wildlife (USDA Forest Service 2003c) that occupy the KNF. MIS were chosen based on the following criteria: (1) the species can be easily monitored and (2) the species is susceptible to changes resulting from management activities. It is assumed that effects on MIS can be correlated to effects on other species with similar habitat requirements.

3.24.3.1 Regulatory Framework

Under NFMA guidelines, Forest Plans shall “provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives…” (16 USC 1604(g)(3)(B)). The KFP states “the maintenance of viable populations of existing native and desirable non-native vertebrate species, as monitored

through indicator species, would be attained through the maintenance of a diversity of plant communities and habitats" (KFP Vol. 1, II-22). The MIS designated for the KNF and the habitat they are intended to represent are identified in the KFP (KFP Vol. 2, Appendix 12), and shown in Table 157.

Table 157. KNF Management Indicator Species.

Species	Habitat Represented	Comments
Grizzly Bear (*Ursus arctos*)	General Forest	See section 3.24.5, *Threatened, Endangered, and Proposed Species*
Gray Wolf (*Canis lupus*)	General Forest	See section 3.24.4, *Forest-Sensitive Species*
Bald Eagle (*Haliaeetus leucocephalus*)	Rivers and Lakes	See section 3.24.4, *Forest-Sensitive Species*
Peregrine Falcon (*Falco peregrinus*)	Cliffs	See section 3.24.4, *Forest-Sensitive Species*
Elk (*Cervus elaphus*)	General Forest	
White-tailed Deer (*Odocoileus virginianus*)	General Forest	
Mountain Goat (*Oreamnos americanus*)	Alpine	
Pileated Woodpecker (*Dryocopus pileatus*)	Snag Habitat, Old Growth	See sections 3.21.2, *Old Growth Ecosystems* and 3.24.2, *Key Habitats*

The MIS described in this section are elk, white-tailed deer, mountain goat, and pileated woodpecker. Impacts to the grizzly bear are addressed in section 3.24.5, *Threatened, Endangered, and Proposed Species* and impacts to the bald eagle, peregrine falcon, and gray wolf are described in section 3.24.4, *Forest-Sensitive Species*.

Elk and white-tailed deer are MIS species that represent similar habitat (general forest). The KNF and the FWP have developed management emphasis designations for elk by PSU (Johnson 2004a). Management emphasis ratings are high in PSUs where maintaining elk security is a high priority, medium where elk are one of the primary resource considerations, and low where elk management is not a priority. The PSUs potentially affected by the Montanore Project are the Crazy and Silverfish PSUs. The Crazy PSU is assigned a medium elk emphasis rating, while the Silverfish PSU is assigned a high elk emphasis rating. Based on these management emphasis ratings, KFP direction, the biological potential of the area, state wildlife management objectives, public comments during scoping, information contained within the Kootenai Conservation Plan (Johnson 2004a), and site-specific knowledge of deer and elk use in the Crazy and Silverfish PSUs, the elk was selected as the general forest indicator for the Silverfish PSU and the white-tailed deer was selected as the general forest indicator for the Crazy PSU.

The MFSA directs the DEQ to approve a transmission line if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impact,

considering the state of available technology and the nature and economics of the various alternatives. An assessment of effects on big game species is part of the transmission line certification process. FWP is required to report DEQ information relating to the impact of the proposed site on FWP's area of expertise. The report may include opinions as to the advisability of granting, denying, or modifying the certificate.

3.24.3.2 Elk

3.24.3.2.1 Analysis Area and Methods

Elk population ecology, biology, habitat description, and relationships identified by research are described in Murie (1979) and Toweill and Thomas (2002). That information is incorporated by reference. Elk population and harvest data come primarily from FWP. Additional information is provided by recent District wildlife observation records and KNF historical data (NRIS FAUNA).

The analysis area for evaluating direct and indirect project impacts to individuals and their habitat on the KNF is the Silverfish PSU (Figure 87). The analysis areas for determining direct, indirect, and cumulative effects in the KNF are the FWP hunting district (HD) 104 and the KNF, respectively. To evaluate potential direct and indirect impacts of the transmission line on elk on private and state land, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. The Silverfish PSU and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments is the analysis area for cumulative effects on elk.

The effects analysis in the KNF is based on direction provided in the KFP (as amended) and Lyon *et al.* (1985). Additional guidance is provided by Hillis *et al.* (1991). Data sources used in this analysis include FWP hunting and population data, research, and plans; District vegetation layers; INFRA roads layers; TSMRS data; Summerfield (1991); and field surveys by District biologists and data collection crews. Potential effects to elk in the KNF are evaluated according to five effects indicators: cover/forage ratio, forage openings, habitat effectiveness (HE), security, and key habitat features. These indicators are described below.

As described in section 2.4.6.3, *Grizzly Bear Mitigation Plan*, MMC's proposed Alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the year-long change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include yearlong access changes through the installation of barriers or gates in National Forest System roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in elk HE, elk security, and road density calculations. Additional road access changes may also occur on land acquired as part of the grizzly bear mitigation proposed by MMC or the agencies (see sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*). Elk HE, elk security, and road density calculations do not take into account the effect of land acquisition programs proposed by MMC and the agencies. Other mitigation measures incorporated into MMC's or the agencies' alternatives that could benefit elk include winter construction timing restrictions in elk winter range, prohibiting employees from carrying firearms, and monitoring road-killed animals along mine access roads to determine if improved access resulted in increased wildlife mortality.

Impacts to elk on private and state land from the transmission line corridor were evaluated based on FWP winter habitat mapping (Figure 87); elk security generated from KNF roads data; FWP hunting and population data, research, and plans; KNF and FWP information on wildlife linkage areas; and mapping of broad vegetation types shown on Figure 83.

Cover/Forage Ratios

An important consideration when evaluating big game habitat is the distribution of cover and forage within a given area. Cover can be described as vegetation that provides protection from weather, predators, and humans. Two types of cover are considered for this analysis: hiding and thermal cover, based on Thomas (1979). Hiding cover is defined as vegetation capable of hiding 90 percent of an elk from human view at 200 feet. Thermal cover is defined as stands of conifers at least 40 feet tall with 70 percent crown closure. Forage areas are natural or man-made areas that do not qualify as either hiding or thermal cover. Reexamination of elk use of thermal cover and foraging areas indicates that providing thermal cover does not compensate for inadequate forage conditions (Cook *et al.* 1998). The ratio of cover to forage represents the percentage of the PSU that meets elk requirements for both cover and forage.

Effects of the alternatives on cover and forage are evaluated based on cover/forage ratios for summer and winter range, percent cover for combined MAs 15, 16, 17, and percent thermal cover on winter range in the Silverfish PSU. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. The KFP recommends a cover/forage ratio of 30/70 percent for elk winter range (for MA 10 and 11 combined). MAs 10 and 11 were delineated for the KFP and do not entirely overlap with elk winter range mapped by FWP (Figure 87). To avoid confusion with FWP winter range, for impacts evaluated on National Forest System land, winter range is referred to as MAs 10 and 11. Summerfield (1991) recommends 60 percent cover on winter range and summer range combined (for all MAs). On elk winter range, the cover should be at least 40 percent thermal cover (ibid.). Summer range cover may include any combination of hiding and thermal cover (ibid.). The KFP guideline for hiding and thermal cover on MAs 15, 16, and 17 for elk is greater than 15 percent. MAs 15, 16, and 17 are managed for timber production and do not necessarily correspond to areas of seasonal elk use.

Forage Openings

In general, use of foraging areas decreases when big game is required to venture more than 600 feet from cover (Thomas 1979). According to KFP guidelines, maximum opening size on National Forest System lands should generally be less than 40 acres. Summerfield (1991) recommends the same opening size as the grizzly bear (a maximum of 600 feet to cover from any point inside an opening). Forage openings are identified through TSMRS database queries to determine type and age of past harvest. For this analysis, effects of forest openings on elk are evaluated based on the regeneration harvest greater than 40 acres occurring after 1986.

Habitat Effectiveness

The HE of an area refers to the percentage of habitat without open roads that is usable by elk outside of the hunting season. Numerous studies have shown that a strong negative correlation exists between elk use of an area and the density of open roads, even if those roads are only lightly traveled (Frederick 1991). Open road density (ORD) is measured as miles of open roads per square mile (mi/mi^2).

Effects of alternatives on HE are evaluated based on percent HE, ORD for MA 12, and ORD for the combined MA 15, 16, 17, and 18 lands in the Silverfish PSU. The KFP standard for ORD in

MA 12 (managed for big game summer range and timber production) is less than 0.75 mi/mi^2, or greater than 68 percent HE (Lyon 1984). On MAs 15, 16, 17, and 18, the KFP ORD standard is less than 3.0 mi/mi^2, which equates to 38 percent HE. The KFP does not provide ORD standards for winter range (MAs 10 and 11); road use and timber harvest activities would normally be restricted during the winter in these MAs (December 1 to April 30).

Security Habitat

Security habitat offers elk refuge and reduces their vulnerability during the hunting season, and can greatly influence the age structure and composition of a herd. The KFP has no standard for security areas. In 1996, a panel of state and federal wildlife biologists identified security areas as an important component of elk habitat requirements and agreed that it should be quantified based on methods used by Hillis *et al.* (1991) (Johnson 2004a). For this analysis, elk security habitat is defined as areas that are larger than 250 contiguous acres and more than 0.5 mile from an open road, according to Hillis *et al.* (1991).

According to Hillis *et al.* (1991), 30 percent of an elk's fall use area should be maintained as security habitat. Since elk fall use areas could be anywhere within a PSU, the 30 percent minimum elk security standard is applied to all lands within a PSU. Security levels are defined in Appendix H-B of Johnson (2004a).

Key Habitat Features

Moist environments are important to elk, providing high-quality forage, allowing regulation of body temperature, and providing wallowing areas used primarily by bull elk during the breeding season (Lyon *et al.* 1985; Toweill and Thomas 2002). Effects of the alternatives on key habitat features will be evaluated based on the number of wallows, wet meadows, and bogs potentially impacted.

Movement Areas

According to KFP direction, activities such as timber harvest should not interfere with wildlife movement patterns, and forested cover should be provided in harvest and thinning areas as movement corridors for wildlife in summer and winter range. In the KNF, movement corridors along ridgetops are especially important for elk. The analysis of impacts to movement corridors is based on District GIS mapping of topographical contours and is available in the KNF project record.

3.24.3.2.2 Affected Environment

The Silverfish PSU is located in elk HD 104, which is one of six hunting districts in the Lower Clark Fork Elk Management Unit (EMU), described in the Statewide Elk Management Plan (FWP 2004a). The FWP evaluates elk population composition and trends based on total elk, calf/cow ratios, and bull/cow ratios observed during sampling surveys of a portion of the HD referred to as trend areas, harvest data, and hunter effort data (Brown, pers. comm. 2008). The area near the proposed mine facilities is not surveyed during trend surveys, and the most recent trend area survey for HD 104 was conducted in 2003 (FWP 2007a). The average number of elk observed in the trend area for HD 104 from 1999 to 2003 was 193 elk, including an average of 14 bulls (FWP 2004b). Trend area survey goals established by the Statewide Elk Management Plan for HD 104 are between 180 and 270 elk (FWP 2004b). Heavy snowfall during the winter of 1996 to 1997 in northwest Montana resulted in higher than average winter mortality and poor calf production the following spring. In general, all parameters of the elk population in northwest

Montana have increased since the winter of 1996 to 1997 (FWP 2004a). Overall, the elk population in HD 104 has stabilized. Although high snowfall during the winter of 2007 to 2008 resulted in relatively high elk mortality and low calf production, impacts were significantly less than from the winter of 1996 to 1997 (Brown, pers. comm. 2008). The eastern segments of the transmission line alternatives would occur in HD 103, which is in the Salish EMU. An annual average of 152 elk, including 12 bulls, was observed during trend area surveys in HD 103 from 1977 to 2003 (FWP 2004b). Trend area survey goals for HD 103 are 260 elk (FWP 2004b). Some of the larger concentrations of elk in HD 103 occur in the Fisher and Thompson River valleys.

Cover/Forage

As of the end of 2007, elk summer range in the Silverfish PSU is comprised of 99 percent cover and 1 percent forage habitat, while MAs 10 and 11 are comprised of 97 percent cover and 3 percent forage habitat. Cover to forage ratios in the Silverfish PSU indicate that the proportion of forage habitat is well below recommended levels. As noted in the Statewide Elk Management Plan (FWP 2004b), the quality of winter elk forage productivity is declining in the Lower Clark Fork EMU due to conifer encroachment, noxious weed infestations, and aging shrubs. The proportion of thermal cover in winter range is 21 percent, which is below the 40 percent minimum recommended by Summerfield (1991). MAs 15, 16, and 17 in the Silverfish PSU consist of 86 percent thermal and hiding cover combined, which is greater than the recommended 15 percent minimum.

Habitat Effectiveness, Security Habitat, and Open Road Density

Elk security habitat and HE levels are currently greater than desired (57 percent and 76 percent, respectively). Current ORD in the Silverfish PSU is 1.30 mi/mi^2 in MA 12, and 0.8 mi/mi^2 in MAs 15, 16, 17, and 18. ORD for MAs 15, 16, 17, and 18 in the Silverfish PSU meets KFP standards and ORD for MA 12 in the Silverfish PSU does not.

Forage Openings

The Silverfish PSU contains 15 openings greater than 40 acres. The distance to cover may discourage elk from foraging in portions of these openings.

Key Habitat Features

Wetland and riparian areas are described in sections 3.21, *Vegetation* and 3.22, *Wetlands and Other Waters of the U.S.* About 146 acres of wetlands that provide potential wallowing areas for elk occur in the Silverfish PSU.

Movement Areas

Movement corridors along ridgetops are especially important for elk, and most of these areas or travel ways are intact.

Impacts to Elk on State or Private Lands

Elk winter range is shown on Figure 87. The Montanore Project potentially affects elk winter range in the Fisher River and West Fisher Creek corridors and the southern exposures of Miller Creek. The majority of state and private land is heavily roaded and does not provide security habitat for elk (Figure 87).

Following a process developed by Servheen et al. (2003) and the Interagency Grizzly Bear Committee (IGBC) (2001), a wildlife linkage zone has been identified in the Fisher River Valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2 and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (Figure 87) (see KNF project file for description of linkage zone). A linkage zone is defined as "the area between larger blocks of habitat where animals can live at certain seasons and where they can find the security they need to successfully move between these larger habitat blocks" (IGBC 2001). U.S. 2 in the Fisher River Valley between Raven and Brulee creeks is a crossing area for many species of wildlife, including elk, white-tailed deer, grizzly bear, and moose migrating between summer ranges in the Cabinet Mountains and winter ranges in the Salish Mountains (Brown, pers. comm. 2008). Private land occupies the areas adjacent to U.S. 2 in this linkage area, most of which is heavily roaded and has been logged in the past 20 to 30 years. Regeneration has occurred on some of the logged stands, providing potential hiding cover.

3.24.3.2.3 Environmental Consequences

Impacts to elk habitat and percent elk security, habitat effectiveness, and open road densities in the Silverfish PSU and private and state lands in the analysis area from the various project features of the transmission line alternatives are shown in Table 158 and Table 159, and described in the following subsections. Elk is the MIS for the Silverfish PSU. Impacts associated with the mine alternatives would be limited to the Crazy PSU, where the white-tailed deer is the MIS for general forest species. Impacts to white-tailed deer in the Crazy PSU are described in the *White-tailed Deer* subsection.

Alternative A – No Transmission Line

Alternative A would not impact elk habitat. Forage habitat would decrease over time unless harvest or other events, such as a wildfire or windstorm, created additional forage. Large-scale fires could potentially occur in the Silverfish PSU. Although vegetative succession would reduce forage openings over time, openings created following large fires would likely be relatively large, with long distances between hiding cover. Until hiding cover develops (about 15 to 20 years, depending on site conditions), individual animals may be more vulnerable to predation and hunting mortality in areas where large openings develop following wildfire. Overall, elk populations would probably be maintained.

Table 158. Impacts to Elk Habitat by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
Silverfish PSU					
Percent Cover/Forage Summer Range[1]	99/1 (60/40)	99/1	99/1	99/1	99/1
Percent Cover/Forage in MAs 10 and 11[2]	97/3(60/40)	96/4	96/4	97/3	95/5
Percent Thermal Cover in MAs 10 and 11[2]	21 (>40)	21	21	21	21
Percent Cover in MAs 15, 16, and 17	86 (>15)	86	86	86	86
# Openings >40 acres[3]	15	16	16	16	16
# Key Habitat Features Affected (acres)[4]	N/A	10	3	13	12
# Movement Areas Affected[5]	N/A	1	2	2	2
All Lands in Analysis Area					
Elk Winter Range Impacted (acres)[6]	0	123	174	149	93

N/A = Does not apply.
Numbers in parentheses represent KFP standards or desired conditions.
[1] Elk summer range includes all MAs except MAs 10 and 11. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[2] MAs 10 and 11 are managed for big game winter range; all MA 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Transmission line corridor is counted as 1 opening. No portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features such as bogs, wallows, and wet meadows are represented by wetlands, as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[5] Movement areas are represented by ridgelines of third order or larger drainages.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Table 159. Percent Elk Security, Habitat Effectiveness, and Open Road Densities in the Silverfish PSU During Transmission Line Construction and Operations.

Habitat Component	[A] No Transmission Line/ Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)		[C] Modified North Miller Creek Transmission Line Alternative		[D] Miller Creek Transmission Line Alternative		[E] West Fisher Creek Transmission Line Alternative	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Percent Security Habitat[3]	57 (>30)	55	57	55	57	55	57	55	57
Habitat Effectiveness[4]	76 (>68)	74	76	74	76	76	76	74	76
ORD in MA 12 (mi/mi^2)[5]	1.30 ($\leq$0.75)	1.40	1.30	1.32	1.30	1.33	1.30	1.70	1.30
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	0.8 (<3.0)	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during mine construction.
[2] Ops = during transmission line operations.
[3] Security habitat is calculated by buffering all roads open during the fall (October 15 to November 30) by 0.5 mile. The remaining area equals the effective habitat. No elk security habitat occurs on private or state land in the analysis area.
[4] Habitat Effectiveness is calculated by buffering all roads open during the summer period (July 1 to October 14) by 0.25 mile. The remaining area within the PSU equals the effective habitat.
[5] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
ORD = open road density. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Cover/Forage

In Alternative B, cover relative to forage habitat would decrease to 96 percent in MAs 10 and 11 in the Silverfish PSU (Table 158). Percent cover relative to forage habitat in summer range; thermal cover in MAs 10 and 11; and percent cover in MAs 15, 16, and 17 in the Silverfish PSU would not change as a result of Alternative B. Alternative B would include the reallocation of MAs 10 and 11 in a 500-foot corridor along the transmission line to MA 23, which does not have a cover/forage standard. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. If revegetation were successful, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving elk habitat conditions in the Silverfish PSU toward KFP objectives. Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation was re-established, redisturbed areas would provide forage habitat. Current populations of elk would likely be maintained in Alternative B.

Open Road Density, Security Habitat, and Habitat Effectiveness

As described in section 2.4.6.3, *Grizzly Bear Mitigation Plan*, Alternative B includes an access change in NFS road #4724 from April 1 to June 30 to mitigate for impacts to grizzly bears. The seasonal access change in NFS road #4724 is taken into account in ORD and elk security habitat calculations.

During Alternative B line construction, ORD in the Silverfish PSU would increase to 1.40 mi/mi^2 in MA 12, where ORD is currently worse than the KFP standard; and 1.0 mi/mi^2 in MAs 15, 16, 17, and 18, where the KFP standard is met (Table 159). ORD would return to existing conditions during transmission line operations. Alternative B would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. Because all new or opened roads in MA 12 associated with the Alternative B would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 would not be necessary. Alternative B would decrease security habitat by 2 percent during construction, but would remain better than the KFP-recommended minimum. Alternative B would decrease habitat effectiveness to 74 percent, but would remain better than the KFP-recommended minimum. Percent security habitat and habitat effectiveness would return to existing levels during transmission line operations.

Although the new road prism in Alternative B would remain during transmission line operations, roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. During the final reclamation phase following mine closure, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated. The increase in ORD and the decrease in security habitat and habitat effectiveness could displace individual elk to less disturbed areas in the short term, until transmission line construction was complete. Overall populations would not likely be affected.

Habitat effectiveness and percent security do not take into account the potential effects of disturbance from helicopter use during line stringing. Helicopter use could contribute to short-term displacement of individual elk from the transmission line corridor. Helicopter use for line stringing would occur during a relatively short period (about 10 days), and overall elk populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of elk during line decommissioning.

Forage Openings

One opening in forest cover greater than 40 acres would be created by the Alternative B transmission line corridor. No point in the transmission line clearing area would be greater than 600 feet from cover.

Key Habitat Features

The clearing area for Alternative B would include about 10 acres of wetland habitat providing potential wallowing areas for elk; most of the wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Alternative B could interfere with elk movement in the Silverfish PSU where it followed the ridge between Midas Creek and Howard Creek. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Alternative B would affect about 123 acres of elk winter range on all lands in the analysis area, primarily in the Miller Creek drainage (Table 158). Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in elk winter range from transmission line construction would be minimized by restricting construction in elk winter range. Alternative B would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in a reduction of elk security habitat and increased elk mortality if hunting access were allowed. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of increased road use and helicopter use. State and private lands currently have high road densities and overall elk populations would not likely be affected.

The eastern segment of the Alternative B transmission line alignment would occur within the wildlife linkage zone in the Fisher River Valley. The proximity of this alignment to U.S. 2 would result in a widening of disturbed area and could potentially discourage elk movement within the linkage zone by decreasing cover. Transmission line construction activities could cause elk to

change their traditional movement patterns within this linkage zone, but these effects would be short-term because human-caused disturbance would cease when the transmission line construction were completed. Once revegetated, cleared areas could provide additional forage habitat. Some shrub and tree cover would be maintained in the transmission line right-of-way because only the largest trees would be removed, and would continue to provide cover. Given that the area of the linkage zone potentially affected by Alternative B is generally heavily roaded and has been logged in the past 20 to 30 years, and given the short-term nature of human-caused disturbance, it is not likely that elk movement within the linkage zone would be greatly affected by Alternative B.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Cover/Forage

The effects of Alternative C on cover-to-forage ratios in the Silverfish PSU would be the same as Alternative B.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative C would include access changes (installation of barriers or gates and public access restrictions) in several roads to mitigate for the loss of big game security and impacts to grizzly bear (see Figure 36). These access changes are taken into account in security, habitat effectiveness, and ORD calculations. During Alternative C line construction, ORD in the Silverfish PSU would increase to 1.32 mi/mi^2 in MA 12, where ORD is currently worse than the KFP standard (Table 159). ORD in MAs 15, 16, 17, and 18 in the Silverfish PSU would not change in Alternative C. ORD would return to existing conditions during transmission line operations. Alternative C would include the reallocation of MAs 11 and 12 in a 500-foot corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. Because all new or opened roads in MA 12 associated with Alternative C would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 would not be necessary. During line construction, Alternative C would result in a decrease in percent security habitat in the Silverfish PSU by 2 percent to 55 percent. Alternative C would decrease habitat effectiveness to 74 percent, but would remain better than the KFP-recommended minimum. Percent security habitat and habitat effectiveness would return to existing levels during transmission line operations.

The status of new or opened roads associated with Alternative C would be the same as Alternative B, except that on National Forest System lands, the status of roads opened or constructed for transmission line access would be changed to intermittent stored service after line installation was completed. Like Alternative B, new roads constructed for Alternative C would remain in the road prism during operations, but would be gated or barriered on National Forest System land after transmission line construction. In Alternative C, new transmission line roads on National Forest System lands would be decommissioned and revegetated after closure of the mine and removal of transmission line. The increase in road use and the decrease in security habitat could displace individual elk to less disturbed areas in the short term, until transmission line construction was complete. Overall populations would not likely be affected.

Habitat effectiveness and percent security do not take into account the potential effects of disturbance from helicopter construction. Helicopter use could contribute to short-term displacement of individual elk from the transmission line corridor, but overall elk populations would not likely be affected. Helicopter line stringing would occur during a relatively short

period (about 10 days). Helicopters also would be used for vegetation clearing and structure construction in some segments, and the resulting disturbance could last up to 2 months. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopters use and other activities could result in short-term disturbance of elk during line decommissioning.

Forage Openings

New forage openings would be the same for Alternative C as Alternative B.

Key Habitat Features

The clearing area for Alternative C would include about 3 acres of wetland habitat providing potential wallowing areas for elk; most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternative C may interfere with elk movement where it followed the ridge between Midas Creek and Howard Creek and the east-facing ridge north of the Sedlak Park Substation. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Alternative C would affect about 174 acres of elk winter range on all lands in the analysis area, primarily in the Miller Creek and Fisher River drainages (Table 158). Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in elk winter range from transmission line construction would be minimized by restricting construction during the winter. Alternative C would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in a reduction of elk security habitat and increased elk mortality if hunting access were allowed. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of increased road use and helicopter use. State and private lands currently have high road densities and overall elk populations would not likely be affected.

A relatively small segment of the Alternative C transmission line would cross the Fisher River Valley in the wildlife linkage zone, potentially discouraging elk movement in a localized area due to transmission line construction activities. These effects would be short-term because human-caused disturbance would cease when the transmission line construction was completed. The segment of Alternative C that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect elk movement in the linkage zone. Given that the area of the linkage zone potentially affected by Alternative C is generally heavily roaded and has been logged in the past 20 to 30 years, and given the short-term nature of human-caused

disturbance, it is not likely that this alternative would greatly affect elk movement within the linkage zone.

Alternative D – Miller Creek Transmission Line Alternative

Cover/Forage

Alternative D would not change the proportion of cover relative to forage habitat in summer range, MAs 10 and 11, or MAs 15, 16, 17, and 18 from existing conditions in the Silverfish PSU.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative D would include the same road access changes described for Alternative C. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same as Alternative C.

Alternative D impacts on ORD, percent security habitat, and habitat effectiveness would be the same as Alternative C except that ORD in MA 12 in the Silverfish PSU would increase to 1.33 during Alternative D construction (Table 159). MA 12 would be reallocated to MA 23, and a KFP amendment to allow for increased ORD in MA 12 would not be necessary.

The impacts of helicopter construction and stringing the transmission line would be the same for Alternative D as Alternative C.

Forage Openings

New forage openings would be the same for Alternative D as Alternative B.

Key Habitat Features

The clearing area for Alternative D would include about 13 acres of wetland habitat providing potential wallowing areas for elk; most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternative D could interfere with elk movement where it followed the east-facing ridge north of the Sedlak Park Substation and crosses the ridge between Miller Creek and Howard Creek. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Impacts of Alternative D on elk winter range would be similar to Alternative C except that Alternative D would affect about 149 acres of elk winter range on all lands in the analysis area, primarily in the Miller Creek and Fisher River drainages (Table 158). Impacts of Alternative D on elk in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Cover/Forage

The effects of Alternative E on cover-to-forage ratios in the Silverfish PSU would be the same as Alternatives C and D except that Alternative E would decrease cover relative to forage habitat in MAs 10 and 11 to 95 percent in the Silverfish PSU. MAs 10 and 11 would be reallocated to MA 23, which does not have a cover/forage standard.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative E would include the same changes in road access described for Alternative C. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same for Alternative E as Alternative C.

Alternative E impacts on ORD and percent security habitat would be the same as Alternative D except that ORD in MA 12 in the Silverfish PSU would increase to 1.7 mi/mi^2 during construction of Alternative E (Table 159). Alternative E would include the same access changes described for Alternative C. The impacts of helicopter construction and stringing the transmission line would be the same for Alternative E as Alternative C.

Forage Openings

New forage openings would be the same for Alternative E as Alternative B.

Key Habitat Features

The clearing area for Alternative E would include about 12 acres of wetland habitat providing potential wallowing areas for elk; most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternative E could interfere with elk movement where it followed the east-facing ridge north of the Sedlak Park Substation and crossed the ridge between West Fisher and Howard creeks. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Of all the transmission line alternatives, Alternative E would affect the least amount of elk winter range (about 93 acres) on all lands in the analysis area, primarily in the Fisher River and West Fisher Creek drainages. Otherwise, impacts of Alternative E on elk winter range would be the same as Alternative C. Impacts of Alternative E on elk in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Combined Mine-Transmission Line Effects

Impacts to elk habitat in the analysis area from combined mine-transmission line alternatives are described below and shown in Table 160.

Cover/Forage

The combined mine-transmission line alternatives would not change the percent cover to forage in summer range; the percent of thermal cover in MAs 10 and 11; or the percent cover in MAs 15, 16, and 17. All alternatives would result in small decreases in cover relative to forage habitat in MAs 10 and 11. All transmission line alternatives would include the reallocation of MAs 10 and 11 in a 500-foot corridor along the transmission line to MA 23, which does not have a cover/forage standard. Alternatives 3E and 4E would result in the greatest reductions in cover and increases in forage habitat. Alternatives 3D and 4D would have the least impact on cover-to-forage ratios.

Open Road Density, Security Habitat, and Habitat Effectiveness

As described in sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*, Alternative B includes an access change in NFS road #4724 from April 1 to June 30 to mitigate for impacts to grizzly bears and the agencies' alternatives would include access changes (installation of barriers or gates and public access restrictions) in several roads to mitigate for the loss of big game security and impacts to grizzly bear. These access changes are taken into account in security, habitat effectiveness, and ORD calculations.

In all action alternatives, the new road prism would remain during transmission line operations. Roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. In the agencies' alternatives, roads would be placed into intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed during the operation period of the mine and prior to their future need. The service roads would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. During the final reclamation phase following mine closure, the transmission line would be removed, roads reclaimed, and all disturbed areas revegetated. In the agencies' alternatives, roads would be decommissioned at mine closure and transmission line decommissioning.

Habitat effectiveness and percent security do not take into account the potential effects of disturbance from helicopters. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C above.

None of the agencies' alternatives would change ORD in MAs 15, 16, 17, and 18, while Alternative 2B would result in a slight increase in ORD in MAs 15, 16, 17, and 18 during transmission line construction (Table 161). During transmission line construction, all action alternatives would increase ORD in MA 12, where ORD is currently better than the KFP standard.

Table 160. Impacts to Elk Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
	TL-A	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Silverfish PSU								
Percent Cover/forage Summer Range[1]	99/1 (60/40)	99/1	99/1	99/1	99/1	99/1	99/1	99/1
Percent Cover/forage in MAs 10 and 11[2]	97/3(60/40)	96/4	96/4	97/3	95/5	96/4	97/3	95/5
Percent Thermal Cover in MAs 10 and 11[2]	21 (>40)	21	21	21	21	21	21	21
Percent Cover in MAs 15, 16, and 17	86 (>14)	86	86	86	86	86	86	86
# Openings >40 acres[3]	15	16	16	16	16	16	16	16
Key Habitat Features Affected (acres)[4]	N/A	10	3	13	12	3	13	12
# Movement Areas Affected[5]	N/A	1	2	2	2	2	2	2
All Lands in Analysis Area								
Elk Winter Range Impacted (acres)[6]	0	123	174	149	93	174	149	93

N/A = Does not apply.
Numbers in parentheses represent KFP standards or desired conditions.
Impacts shown are for the transmission line construction phase, which represents maximum estimated impacts.
[1] Elk summer range includes all MAs except MAs 10 and 11. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[2] MAs 10 and 11 are managed for big game winter range; all MAs 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Transmission line corridor is counted as one opening. Other than the corridor length, no portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features, such as bogs, wallows, and wet meadows, are represented by wetlands, as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[5] Movement areas are represented by ridgelines of third order or larger drainages.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Table 161. Percent Elk Security, Habitat Effectiveness, and Open Road Densities in the Silverfish PSU by Combined Mine and Transmission Line Alternatives.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
		TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Percent Security Habitat[3]	57 (>30)	55	57	55	57	57	57	57	57	55	57	57	57	57	57
Habitat Effectiveness[4]	76 (>68)	74	76	74	76	76	76	74	76	74	76	76	76	74	76
ORD in MA 12 (mi/mi^2)[5]	1.30 (≤0.75)	1.40	1.30	1.32	1.30	1.33	1.30	1.70	1.30	1.32	1.30	1.33	1.30	1.70	1.30
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	0.8 (<3.0)	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during mine construction.
[2] Ops = during transmission line operations.
[3] Security habitat is calculated by buffering all roads open during the fall (October 15 to November 30) by 0.5 mile. The remaining area equals the effective habitat. No elk security habitat occurs on private or state land in the analysis area.
[4] Habitat Effectiveness is calculated by buffering all roads open during the summer period (July 1 to October 14) by 0.25 mile. The remaining area within the PSU equals the effective habitat.
[5] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
ORD = open road density. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

In all action alternatives, ORD would return to existing densities during transmission line operations. All transmission line alternatives would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. Because all new or opened roads in MA 12 associated with the combined action alternatives would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 would not be necessary for these alternatives.

Alternatives 2B, 3C, and 4C would result in a 2 percent reduction in elk security habitat during transmission line construction. Percent elk security habitat would return to existing levels following transmission line construction. Alternatives 3D, 3E, 4D, and 4E would not change percent security habitat.

Alternatives 2B, 3C, 3E, 4C, and 4E would result in a 2 percent decrease in habitat effectiveness in the Silverfish PSU. Following transmission line construction, habitat effectiveness would return to existing levels. None of the other combined mine-transmission line alternatives would affect habitat effectiveness in the Silverfish PSU.

Increases in ORD and the decrease in security habitat and habitat effectiveness could displace individual elk to less disturbed areas in the short term, until transmission line construction was complete. Overall populations would not likely be affected.

Overall, road densities, percent security habitat, and habitat effectiveness would likely improve through MMC's or the agencies' grizzly bear land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve road densities, percent security habitat, and habitat effectiveness where roads could be closed. The agencies' land acquisition program would likely be more effective at reducing road densities than MMC's proposed land acquisition program because more land would be protected.

Forage Openings

In all combined action alternatives, one opening greater than 40 acres would be created. No point in this opening created by the transmission line clearing area would be greater than 600 feet from cover.

Key Habitat Features

Alternatives 3C and 4C would have the least impacts on wetland habitat providing potential wallowing areas for elk in the Silverfish PSU. Impacts of the other combined action alternatives on wetlands would be comparable, ranging from 10 acres for Alternative 2B to 13 acres for Alternatives 3D and 4D. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

The agencies' alternatives may interfere with elk movement where it followed the east-facing ridge north of the Sedlak Park Substation. Alternative 2B would be located at a lower elevation in the Fisher River Valley and would not impact this area. Alternatives 2B, 3C, and 4C may interfere with elk movement where the transmission lines followed the ridge between Midas Creek and Howard Creek. Potential elk movement along the ridge between Miller Creek and Howard Creek

could be affected by Alternatives 4C and 4D. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Elk Winter Range on All Lands

Impacts to elk winter range from the combined action alternatives on all lands in the analysis area, including private and state lands, would range between 93 acres and 173 acres. Alternatives 3C and 3D would have the greatest impacts to winter range, while Alternatives 3D and 3E would have the fewest impacts to winter range. In all combined action alternatives, direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in elk winter range from transmission line construction would be minimized by restricting construction during the winter. All combined action alternatives would result in increased road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in a reduction of elk security habitat and increased elk mortality if hunting access were allowed. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of increased road use and helicopter use. State and private lands currently have high road densities and overall elk populations would not likely be affected.

Wildlife Linkage Zone

The eastern segment of the Alternative 2B transmission line corridor would occur within the wildlife linkage zone in the Fisher River Valley and relatively small segments of all combined action alternatives would cross the Fisher River Valley in the wildlife linkage zone. The portions of the combined agencies' alternative transmission lines that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect elk movement in the linkage zone. Impacts of the combined action alternatives on elk in the Fisher River Valley wildlife linkage zone are the same as described for transmission line Alternatives B, C, D, and E above.

Cumulative Effects

Roads constructed in association with timber harvest, mining, and other development have cumulatively reduced elk security habitat and habitat effectiveness in the analysis area. Development of private lands within the analysis area, including commercial timber harvest, land clearing, home construction, and road construction has contributed to increased disturbance of elk and a loss or reduction in quality of foraging and winter habitat, and is expected to continue. Fire suppression has resulted in the encroachment of conifers into foraging habitat and aging of shrub habitat.

The Miller-West Fisher Vegetation Management Project would occur entirely in the Silverfish PSU and would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. Because of the availability of harvest data, the effects of the Miller-West Fisher Vegetation Management Project can be evaluated quantitatively for cover and forage. Surface impacts from other reasonably foreseeable actions in the Silverfish PSU would be minimal, and would not result in any measurable changes in cover or forage habitat. Cumulative impacts of the Miller-West Fisher

Vegetation Management Project, in combination with the Montanore action alternatives, on cover-to-forage ratios are shown in Table 162. The transmission line action alternatives would not change the percent cover to forage in summer range; the percent of thermal cover in winter range; or the percent cover in MAs 15, 16, and 17; and would not contribute to cumulative changes in these parameters. the transmission line alternatives are not evaluated for cumulative effects on elk.

New roads and access changes for mitigation associated with reasonably foreseeable actions, including the Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, and the Miller-West Fisher Vegetation Management Project, will contribute to cumulative effects on ORD. The No Action alternatives (Alternative 1 and Alternative A) would not contribute to cumulative impacts on elk. Cumulative impacts of the combined mine-transmission line alternatives, in combination with other reasonably foreseeable actions, on percent elk security habitat, habitat effectiveness, and ORD are shown in Table 162. The mine alternatives would not have any effects on elk in the Silverfish PSU, and would not contribute to cumulative effects.

Cover/Forage

All action alternatives, except Alternatives 3D and 4D, in combination with the Miller-West Fisher Vegetation Management Project, would result in cumulative increases in forage habitat relative to cover in MAs 10 and 11. MAs 10 and 11 would be reallocated to MA 23, which does not have a cover/forage standard. Habitat clearing and forest treatments associated with these projects would provide more forage habitat, which would improve overall habitat conditions in elk hunting districts (HD) 103 and 104 and the KNF. Given the existing levels of cover, cumulative effects on cover and forage habitat are not likely to effect elk populations in elk HD number 104 or the KNF.

Open Road Density, Security Habitat, and Habitat Effectiveness

Access changes resulting from Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Miller-West Fisher Vegetation Management Project, and other reasonably foreseeable actions would increase ORD to 1.77 mi/mi^2 in MA 12 and 1.1 mi/mi^2 in MAs 15, 16, 17, and 18. Alternative 2B would increase ORD in MAs 15, 16, 17, and 18 to 1.2 mi/mi^2. In MA 12, Alternatives 2B, 3E, and 4E would increase ORD to 1.85 mi/mi^2, while Alternatives 3D and 4D would increase ORD to 1.80 mi/mi^2. ORD would return to existing conditions during transmission line operations.

Security habitat would be reduced by 10 percent and habitat effectiveness would be reduced by 19 percent as a result of cumulative impacts of the Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Miller-West Fisher Vegetation Management Project, and other reasonably foreseeable actions, but the contribution of the Montanore action alternatives to changes in percent security habitat and habitat effectiveness would not be measurable.

Forage Openings

The combined mine-transmission line alternatives would not create any new openings greater than 40 acres with points greater than 600 feet from cover in the Silverfish PSU, and would not contribute to cumulative increases in forest openings that elk might avoid.

Table 162. Cumulative Impacts to Elk Habitat in the Silverfish PSU by Combined Mine-Transmission Line Alternative.

Measurement Criteria	Existing Conditions	[1] No Mine[1]	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
			TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
			Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]
Percent Cover/forage in MAs 10 and 11[4]	97/3 (60/40)	92/8 (60/40)	91/9	91/9	91/9	91/9	92/8	92/8	90/10	90/10	91/9	91/9	92/8	92/8	90/10	90/10
Percent Security Habitat[5]	57 (>30)	47 (>30)	47	47	47	47	47	47	47	47	47	47	47	47	47	47
Habitat Effectiveness[6]	76 (>68)	57 (>68)	57	57	57	57	57	57	57	57	57	57	57	57	57	57
ORD in MA 12 (mi/mi^2)[7]	1.30 ($\leq$0.75)	1.77 ($\leq$0.75)	1.85	1.77	1.77	1.77	1.80	1.77	1.85	1.77	1.77	1.77	1.80	1.77	1.85	1.77
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	0.8 (<3.0)	1.1 (<3.0)	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

Numbers in parentheses represent KFP standards or desired conditions.
[1] Effects shown include effects of the Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Rock Creek Project, and the Miller-West Fisher Vegetation Management Project. Alternative 1 (No Transmission Line) would not contribute to cumulative effects on ORD.
[2] Const = during mine construction.
[3] Ops = during transmission line operations.
[4] MAs 10 and 11 are managed for big game winter range; all MA 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[5] Security habitat is calculated by buffering all roads open during the fall (October 15 to November 30) by 0.5 mile. The remaining area equals the effective habitat. No elk security habitat occurs on private or state land in the analysis area.
[6] HE is calculated by buffering all roads open during the summer period (July 1 to October 14) by 0.25 mile. The remaining area within the PSU equals the effective habitat.
[7] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
ORD = open road density.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Key Habitat Features

All combined action alternatives would result in the disturbance of wetlands providing potential wallowing habitat for elk in the Silverfish PSU. The clearing area for the combined action alternatives would include between 3 and 13 acres of wetlands. Other reasonably foreseeable actions would contribute to losses of wetland habitat; unavoidable impacts to wetlands in all reasonably foreseeable actions would require compensatory mitigation under the Clean Water Act.

Movement Areas

All combined action alternatives may interfere with elk movement where ridges and drainages were crossed. Disturbance-related impacts would be short-term, and the width of clearing area would not likely be great enough to affect elk movement after the construction phase because sufficient cover would be present. Other reasonably foreseeable actions could impede elk movement in specific areas, but KNF riparian standards would minimize activities in riparian areas, and activities on ridgelines would generally be avoided due to steep terrain. While some cumulative effects to elk movement could occur, they would likely to be minimal.

Elk Winter Range on All Lands

All combined action alternatives, in combination with other reasonably foreseeable actions, especially the Miller-West Fisher Vegetation Management Project, would result in cumulative impacts to elk winter range on all lands in the analysis area, resulting in a reduction of thermal and hiding cover and, once disturbed areas were revegetated, an increase in forage habitat. Cumulative impacts of all combined action alternatives would be minor due to construction timing restrictions in elk winter range. The combined action alternatives, in combination with Plum Creek activities, would result in cumulative disturbance to elk on private lands in the analysis area, and could displace of elk away from areas of disturbance. Private lands are generally heavily roaded and elk in these areas may be habituated to higher levels of disturbance than on National Forest System lands.

3.24.3.2.4 Regulatory/Forest Plan Consistency

KFP. All of the combined agencies' alternatives would meet KFP direction for general forest MIS species (KFP Vol. 1, II-22 #3, III-45 #8 and III-49 #7).

During transmission line construction, all action alternatives would increase ORD in areas currently managed as MA 12 in the Silverfish PSU. All action alternatives would include a project-specific amendment to the KFP to change MA 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment would be for the duration of the proposed Montanore Project. KFP amendments have been discussed section 3.14.4, *Environmental Consequences* in the *Land Use* section. All new or opened roads in MA 12 associated with the transmission line would be within the 500-foot corridor reallocated as MA 23.

State Elk Plan. The analysis area is located in the Lower Clark Fork and Salish Elk Management Units identified in the FWP Statewide Elk Management Plan. None of the combined action alternatives are consistent with that document because they would result in short-term decreases in elk security habitat.

Summary General Forest MIS Statement. Based on the elk analysis and the KNF Conservation Plan (Johnson 2004a), all combined mine-transmission line action alternatives should provide

general forest species habitat with sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all combined mine-transmission line alternatives, sufficient general forest habitat should be available; the populations of species using that habitat should remain viable.

3.24.3.3 White-tailed Deer

3.24.3.3.1 Analysis Area and Methods

White-tailed deer population ecology, biology, habitat description, and relationships identified by research are described in Baty (1995), Mundinger (1981), Morgan (1993), Lyon (1966), Thomas (1979), and Mackie *et al.* (1998).

PSUs are sufficiently large enough to address potential effects of the alternatives on white-tailed deer populations at a landscape level. The analysis area for evaluating direct and indirect project impacts to individuals and their habitat in the KNF is the Crazy PSU (Figure 87). The analysis area for determining direct and indirect effects on white-tailed deer is HD 104 and the KNF. The analysis area for determining cumulative effects on white-tailed deer is the KNF. To evaluate potential direct and indirect impacts of the transmission line on white-tailed deer on private and state land, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. The Crazy PSU and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments is the analysis area for cumulative effects on individual white-tailed deer and their habitat.

Population information is based on HD data provided by FWP. Indicators used to assess effects on white-tailed deer in the KNF are cover/forage ratios, forage openings, ORD, movement areas, and key habitat features affected. Data sources used in this analysis include FWP hunting and population data, research, and plans; District vegetation layers; INFRA roads layers; TSMRS data; Summerfield (1991); and field surveys by District biologists and data collection crews.

As described in sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*, MMC's proposed Alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the yearlong access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include yearlong access changes through the installation of barriers or gates on several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD calculations. Additional road access changes also would occur on land acquired as part of the grizzly bear mitigation proposed by MMC and the agencies. ORD calculations do not take into account the effect of land acquisition programs proposed by MMC and the agencies. Other mitigation measures incorporated into MMC's or the agencies' alternatives that could benefit white-tailed deer include winter construction timing restrictions in white-tailed deer winter range, prohibiting employees from carrying firearms, busing employees to the work site, and monitoring road-killed animals along mine access roads to determine if improved access resulted in increased wildlife mortality.

Impacts to white-tailed deer on private and state land from the transmission line alternatives were evaluated based on FWP winter habitat mapping; (Figure 87); FWP hunting and population data,

research, and plans; KNF and FWP information on wildlife linkage areas; and mapping of broad vegetation types shown on Figure 83.

Cover/Forage Ratios

Cover and forage are defined in section 3.24.3.2, *Elk*. Effects of the alternatives are evaluated based on cover/forage ratios for summer and winter range; percent cover for combined MAs 15, 16, and 17; and percent thermal cover on winter range (MAs 10 and 11) in the Crazy PSU. MAs 10 and 11 were delineated for the KFP and do not entirely overlap with white-tailed deer winter range mapped by FWP (Figure 87). MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. To avoid confusion with FWP winter range, for impacts evaluated on National Forest System land, winter range is referred to as MAs 10 and 11. The KFP recommends a cover/forage ratio for white-tailed deer of 70 percent to 30 percent for MAs 10 and 11 combined. Summerfield (1991) recommends a cover of 70 percent on winter and 60 percent on summer range (for all MAs not managed for deer winter range). On white-tailed deer winter range, the cover should be at least 50 percent thermal cover (Id.). Summer range cover may be in any combination of hiding and thermal cover (Id.). The KFP guideline for hiding and thermal cover on MAs 15, 16, and 17 combined for white-tail deer is greater than 30 percent. MAs 15, 16, and 17 are managed for timber production and do not necessarily correspond to areas of seasonal white-tailed deer use.

Open Road Densities

Effects of roads on white-tailed deer are not well documented. White-tailed deer are more secretive and have smaller home ranges than elk, and may be less likely to avoid roads than elk (Lyon 1979), especially where cover is dense. Roads may increase white-tailed deer vulnerability to hunting season mortality by facilitating hunter access and eliminating refugia (Idaho Department of Fish and Game 2004). KFP standards for ORD are the same for white-tailed deer as described for elk.

Forage Openings

For white-tailed deer, the KFP recommends avoiding the creation of openings greater than 20 acres between areas of cover in MAs 11 and 12. MA 12 is managed to enhance big game non-winter habitat. In MA 10, timber is generally only harvested to maintain or enhance big game winter range, and opening size is minimized. Summerfield (1991) recommends that the opening size be the same as the standard for grizzly bear (a maximum of 600 feet to cover from any point inside an opening). TSMRS forage openings are identified through TSMRS database queries to determine type and age of past harvest. For this analysis, effects of forest openings on deer are evaluated based on the regeneration harvest greater than 20 acres occurring after 1986.

Movement Areas

For white-tailed deer, the corridor of thermal cover between openings that do not provide thermal cover in winter range should be at least 600 feet wide or as wide as the opening, whichever is greater (Summerfield 1991). In the KNF, movement corridors along riparian areas and ridges are especially important for white-tailed deer. The analysis of impacts to movement corridors is based on District GIS mapping of thermal cover in winter range and riparian areas and is available in the KNF project record.

Key Habitat Features

Moist environments are important to white-tailed deer, especially in late summer to early fall, providing water and high-quality forage and allowing regulation of body temperature (Idaho Department of Fish and Game 2004). Effects of the alternatives on key habitat features will be evaluated based on the number of wet meadows and bogs potentially impacted.

3.24.3.3.2 Affected Environment

White-tailed deer are the most abundant and widespread big game animal in the KNF (USDA Forest Service 2005c). The Crazy PSU is within HD 104. The eastern portions of the transmission line alternatives would occur in HD 103. The FWP evaluates deer population composition and trends based on total deer, fawn/doe ratios, and buck/doe ratios observed during sampling surveys of a portion of the HD referred to as trend areas, harvest data, and hunter effort data (Brown, pers. comm. 2008). Heavy snowfall during the winter of 1996 to 1997 in northwest Montana resulted in higher than average winter mortality and poor fawn production the following spring. In general, white-tailed deer populations in northwest Montana have increased since the winter of 1996 to 1997 (FWP 2008b). Overall, the white-tailed deer populations in HDs 103 and 104 have stabilized. High snowfall during the winter of 2007 to 2008 resulted in relatively high winter mortality and low fawn production, resulting in the lowest observed ratio of fawns to adults in northwest Montana since 1998 (FWP 2008b).

Cover/Forage

Currently, white-tailed deer summer range in the Crazy PSU is comprised of 96 percent cover and 4 percent forage habitat, while MAs 10 and 11 are comprised of 83 percent cover and 17 percent forage habitat (Figure 87). The proportion of thermal cover in MAs 10 and 11 is 10 percent. In comparison to the 50 percent minimum recommended by Summerfield (1991), thermal cover is not adequately provided in the Crazy PSU. MAs 15, 16, and 17 in the Crazy PSU consist of 85 percent thermal and hiding cover combined, which is greater than the recommended 30 percent minimum. MAs 15, 16, 17, and 18 have a limited distribution in the Crazy PSU. Cover to forage ratios in the Crazy PSU indicate that while cover is abundant, thermal cover and forage habitat may be lacking in the Crazy PSU. Forage habitat is underestimated because white-tailed deer will forage underneath forest canopies and in harvested areas currently mapped as cover. Most forage habitat occurs in lower elevation areas of the Little Cherry Creek drainage and the mouths of its tributaries, or in isolated patches of past disturbance. Overall forage habitat in the Crazy PSU is well distributed.

Open Road Density

The Crazy PSU contains 93 acres of allocated summer range (MA 12). Current ORD in the Crazy PSU are 4.91 mi/mi^2 in MA 12, and 4.9 mi/mi^2 in MAs 15, 16, 17, and 18. Road density standards are not met for either MA 12 or MAs 15, 16, 17, and 18. ORD worse than the standard may increase mortality during hunting season by facilitating hunter access.

Forage Openings

Recently, created forage openings in MAs 11 and 12 range from less than 1 acre to 320 acres. The Crazy PSU contains six openings greater than 20 acres in MAs 11 and 12. Of the six openings, five have points greater than 600 feet from cover. The distance to cover may discourage white-tailed deer from foraging in these openings.

Movement Areas

Movement corridors along drainage bottoms and ridgetops are especially important for many wildlife species; most of these areas or travel ways are intact. Portions of private land along Libby Creek may lack suitable cover, especially where timber harvests have occurred, affecting the ability of some species to move freely or securely through these areas.

Key Habitat Features

Wetland and riparian areas are described in sections 3.21, *Vegetation* and 3.22, *Wetlands and Other Waters of the U.S.* About 172 acres of wetlands occur in the Crazy PSU.

Impacts to White-tailed Deer on State or Private Lands

As shown on Figure 87, only a small portion of white-tailed deer winter range occurs in the Crazy PSU, along the lower reaches of Bear Creek. White-tailed deer winter range potentially affected by the transmission line alternatives occurs in the Fisher, West Fisher, and Miller creek corridors. The majority of state and private lands has been harvested for timber and currently has high road densities.

A wildlife linkage zone important to white-tailed deer has been identified in the Fisher River Valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2 and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (see KNF project record). A detailed description of this wildlife linkage zone is provided in the elk analysis.

3.24.3.3.3 Environmental Consequences

The white-tailed deer is the MIS for the Crazy PSU. Impacts to white-tailed deer habitat and open road densities in the Crazy PSU and private and state lands in the analysis area from the various project features of the combined mine-transmission line alternatives are shown in Table 163, Table 164, and Table 165, and are described in the following subsections.

Alternative 1 – No Mine

Impacts to white-tailed deer habitat from the mine alternatives are shown in Table 163. Alternative 1 would not have direct or indirect impacts on white-tailed deer or their habitat. Forage habitat would decrease over time unless harvest or other events, such as a wildfire or windstorm, created additional forage. Large-scale fires could potentially occur in the Crazy PSU. Although vegetative succession would reduce forage openings over time, openings created following large fires would likely be relatively large, with long distances between hiding cover. Until hiding cover develops (about 15 to 20 years, depending on site conditions), individual animals may be more vulnerable to predation and hunting mortality in areas where large openings develop following wildfire. Overall, white-tailed deer populations would probably be maintained.

Alternative 2 – MMC's Proposed Mine

Alternative 2 would reduce the percent of cover habitat relative to forage habitat to 92 percent in summer range and to 82 percent cover habitat relative to forage in winter MAs 10 and 11, moving the cover-to-forage ratios toward the KFP-recommended conditions (Table 163). Most areas disturbed as a result of Alternative 2 would not be available as forage habitat until after mine closure and reclamation. Some areas would be reclaimed during operations and would provide foraging habitat once vegetation was established. In the long term, if reclamation were successful, areas disturbed by Alternative 2 would increase the amount of forage available for white-tailed

Table 163. Impacts on White-tailed Deer Habitat in the Crazy PSU by Mine Alternative.

Habitat Component	[1] No Mine/ Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative	[4] Agency Mitigated Little Cherry Creek Impoundment Alternative
Percent Cover/forage Summer Range[1]	96/4 (60/40)	92/8	93/7	93/7
Percent Cover/forage in MAs 10 and 11[2]	83/17 (70/30)	82/18	82/18	82/18
Percent Thermal Cover in MAs 10 and 11[2]	10 (≥50)	10	10	10
Percent Cover in MAs 15, 16, and 17	86 (≥30)	83	85	83
ORD in MA 12 (mi/mi^2)	4.91 (≤0.75)	4.91	4.91	4.91
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	4.9 (≤3.0)	4.9	3.8	3.8
# Openings >20 acres in MAs 11 and 12	6	7	7	7
Key Habitat Features Affected (acres)[3]	N/A	37	14	37
# Movement Areas Affected[4]	N/A	3	3	4

N/A = Does not apply.
Numbers in parentheses represent KFP standards or desired conditions.
Impacts to white-tailed deer habitat would be the same for construction and operations phases.
[1] White-tailed deer summer range includes all MAs except MAs 10 and 11. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[2] MAs 10 and 11 are managed for big game winter range; all MAs 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Key habitat features, such as bogs and wet meadows, are represented by wetlands, as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[4] Movement areas are represented by ridgelines of third order or larger drainages and riparian areas.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 164. Impacts to White-tailed Deer Habitat by Transmission Line Alternative.

Habitat Component	[A] No Trans-mission Line/Existing Conditions	[B] MMC's Proposed Trans-mission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Trans-mission Line Alternative	[D] Miller Creek Trans-mission Line Alternative	[E] West Fisher Creek Trans-mission Line Alternative
Crazy PSU					
Percent Cover/forage Summer Range[1]	96/4 (60/40)	96/4	96/4	96/4	96/4
Cover/forage Ratio in MAs 10 and 11[2]	83/17 (70/30)	83/17	83/17	83/17	83/17
Percent Thermal Cover in MAs 10 and 11[2]	10 (>50)	10	10	10	10
Percent Cover in MAs 15, 16, and 17	86 (>30)	86	86	86	86
# Openings >20 acres in MAs 11 and 12[3]	6	7	7	7	7
Key Habitat Features Affected (acres)[4]	N/A	2	3	13	13
# Movement Areas Affected[5]	N/A	3	3	2	2
All Lands in Analysis Area					
White-tailed Deer Winter Range[6]	N/A	149	191	208	179

N/A = Does not apply.
Values in parentheses represent standards.
Impacts to deer habitat would be the same for construction and operations phases.
[1] White-tailed deer summer range includes all MAs except MAs 10 and 11. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[2] MAs 10 and 11 are managed for big game winter range; all MAs 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Transmission line corridor is counted as one opening. No portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features, such as bogs, wallows, and wet meadows, are represented by wetlands, as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[5] Movement areas are represented by ridgelines of third order or larger drainages and riparian areas.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Table 165. Open Road Densities in the Crazy PSU During Transmission Line Construction and Operations.

Habitat Component	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)		[C] Modified North Miller Creek Transmission Line Alternative		[D] Miller Creek Transmission Line Alternative		[E] West Fisher Creek Transmission Line Alternative	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
ORD in MA 12 (mi/mi^2)[3]	4.91 (≤0.75)	4.91	4.91	4.91	4.91	5.41	4.91	5.41	4.91
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	4.9 (≤3.0)	5.1	5.0	3.7	3.7	3.8	3.7	3.8	3.7

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during transmission line construction.
[2] Ops = during transmission line operations.
[3] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

deer, thereby moving toward KFP objectives for forage habitat. The proportion of thermal cover in MAs 10 and 11 would not change as a result of Alternative 2 and would continue to be less than the desired minimum. All MAs 10 and 11 within the permit areas of the plant site, the tailings impoundment, and LAD Areas 1 and 2 would be reallocated to MA 31, which does not have a cover/forage standard. Percent cover in MAs 15, 16, and 17 in the Crazy PSU would be 3 percent less than existing conditions, but would continue to be greater than the 30 percent KFP guideline minimum. Current populations of white-tailed deer would likely be maintained in Alternative 2.

Open Road Density

As described in section 2.4.6.3, *Grizzly Bear Mitigation Plan*, Alternative 2 includes the yearlong access change in a segment of NFS road #4784. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation.

Alternative 2 would not result in changes to existing ORD in MA 12 or MAs 15, 16, 17, and 18 in the Crazy PSU (Table 163). ORD would continue to exceed standards in MA 12 and MAs 15, 16, 17, and 18 in the Crazy PSU, remaining at 4.91 mi/mi^2 in MA 12 and 4.9 mi/mi^2 in MAs 15, 16, 17, and 18.

Overall, road densities would likely improve through MMC's proposed land acquisition program for grizzly bear mitigation, as described in section 2.4.6.3, *Grizzly Bear Mitigation Plan*. Acquired parcels would be managed for grizzly bear use in perpetuity, and could decrease road densities where roads could be gated or barriered, thereby benefitting white-tailed deer.

Widening, improvement, and yearlong access of the Bear Creek Road could lead to increased vehicle volumes and speed, which could increase the risk of white-tailed deer mortality from vehicle collisions.

At mine closure, all new roads (except the Bear Creek access road) constructed for the project would be reclaimed, which includes grading to match the adjacent topography, obliterating the road prism.

Forage Openings

Alternative 2 would create one opening greater than 20 acres in MAs 11 and 12 along the Bear Creek Road near U.S. 2. Effects on white-tailed deer of this new opening would likely be minimal because no point would be more than 600 feet to cover, and due to its proximity to busy roads. The loss in forage capacity may impact individual white-tailed deer in the short term, until disturbed areas were successfully revegetated. Overall populations of white-tailed deer would not likely be affected.

Movement Areas

Alternative 2 could affect potential white-tailed deer movement corridors in the Little Cherry, Poorman, and Ramsey creek drainages where the tailings impoundment, plant site, and LAD Areas would be constructed, and where other mine-related activities would occur. Facilities associated with Alternative 2 would not occur on ridgetops and would not likely directly interfere with white-tailed deer movement in these areas. Individual animals may have to adjust their localized movement patterns, but no movement barriers would be created by Alternative 2.

Key Habitat Features

About 37 acres of wetlands providing water and high-quality forage would be impacted by Alternative 2 in the Crazy PSU. Impacts to wetlands would be mitigated through implementation of the Wetland Mitigation Plan described in section 2.4.6.1, *Wetland Mitigation Plan*.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Cover/Forage

Impacts of Alternative 3 on cover-to-forage ratios would be similar to Alternative 2 except that in Alternative 3, cover relative to forage habitat would be 93 percent in summer range, and the percent cover in MAs 15, 16, and 17 in the Crazy PSU would be 2 percent less than existing conditions (Table 163).

Open Road Density

As shown in Figure 36, Alternative 3 would include access changes (installation of barriers or gates and public access restrictions) for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD calculations. Alternative 3 would not affect ORD in MA 12, but would improve ORD in MAs 15, 16, 17, and 18 to 3.8 mi/mi^2 (Table 163). ORD would continue to be worse than standards in MA 12 and MAs 15, 16, 17, and 18 in the Crazy PSU.

Overall, road densities would likely improve through the agencies' proposed land acquisition program for grizzly bear mitigation, as described in section 2.5.7.3, *Wildlife Mitigation*. Acquired parcels would be managed for grizzly bear use in perpetuity, and could decrease road densities where roads could be gated or barriered, thereby benefitting white-tailed deer.

Widening, improvement, and yearlong access of the Bear Creek Road could lead to increased vehicle volumes and speed, which could increase the risk of white-tailed deer mortality from

vehicle collisions. For Alternative 3, wildlife mortality due to vehicle collisions would be monitored. If, in consultation with the FWP, wildlife mortality from road-killed animals were found to be excessive, mitigation measures would be developed to reduce mortality risks. The transportation plan for Alternative 3, which includes busing employees to the work site, also would reduce the risks of deer mortality from vehicle collisions.

Forage Openings

New openings created by Alternative 3 would be the same as Alternative 2.

Movement Areas

Alternative 3 could affect potential white-tailed deer movement corridors in the Little Cherry, Poorman, and Libby creek drainages where the tailings impoundment, plant site, and LAD Areas would be constructed, and where other mine-related activities would occur. Alternative 3 would affect fewer riparian corridors than Alternative 2 because disturbance from the plant and adits would be concentrated in Libby Creek. Also, the Alternative 3 impoundment would occupy less of the Little Cherry Creek riparian corridor than the Alternative 2 impoundment. Facilities associated with Alternative 3 would not occur on ridgetops and would not directly interfere with white-tailed deer movement in these areas. Individual animals may have to adjust their localized movement patterns, but it is likely that no movement barriers would result.

Key Habitat Features

About 14 acres of wetlands providing water and high-quality forage would be impacted by Alternative 3 in the Crazy PSU (Table 163). Impacts to wetlands would be mitigated through implementation of the Wetland Mitigation Plan described in 2.5.7.1, *Wetland Mitigation*.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Cover/Forage

Impacts of Alternative 4 on cover-to-forage ratios for summer range and MAs 10 and 11 would be the same as Alternative 3, except that percent cover in MAs 15, 16, and 17 in the Crazy PSU would decrease by 3 percent to 83 percent (Table 163).

Open Road Density

As shown in Figure 36, Alternative 4 would include access changes (installation of barriers or gates and public access restrictions) for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD calculations. The effects of Alternative 4 on road density would be the same as Alternative 3.

Forage Openings

New openings created by Alternative 4 would be the same as Alternative 2.

Movement Areas

Impacts of Alternative 4 on movement areas would be the same as Alternative 2.

Key Habitat Features

Impacts to key habitat features from Alternative 4 would be the same as Alternative 2.

Alternative A – No Transmission Line

Alternative A would not impact white-tailed deer or their habitat. Forage habitat would decrease over time unless harvest or other events, such as a wildfire or windstorm, created additional forage. Large-scale fires could potentially occur in the Crazy PSU. Although vegetative succession would reduce forage openings over time, openings created following large fires would likely be relatively large, with long distances between hiding cover. Until hiding cover develops (about 15 to 20 years, depending on site conditions), individual animals may be more vulnerable to predation and hunting mortality in areas where large openings develop following wildfire. Overall, white-tailed deer populations would probably be maintained.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Cover/Forage

Alternative B would not change cover relative to forage habitat in summer range, MAs 10 and 11, percent thermal cover in MAs 10 and 11, or percent cover in MAs 15, 16, and 17 in the Crazy PSU (Table 164). The proportion of thermal cover in MAs 10 and 11 would continue to be below minimum recommended levels. Percent cover in MAs 15, 16, and 17 in the Crazy PSU would continue to meet the 30 percent recommended level. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. If revegetation were successful, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving white-tailed deer habitat conditions in the Crazy PSU toward KFP objectives. Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation re-established, redisturbed areas would provide forage habitat. Current populations of white-tailed deer would likely be maintained in Alternative B.

Open Road Density

Alternative B includes the yearlong access change in a segment of NFS road #4784. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation.

During Alternative B line construction, ORD in the Crazy PSU would not change in MA 12 and would increase to 5.1 mi/mi^2 in MAs 15, 16, 17, and 18 (Table 165). ORD in MAs 15, 16, 17, and 18 would be 0.1 mi/mi^2 worse than existing densities during transmission line operations. Although ORD in the Crazy PSU would continue to exceed KFP standards, Alternative B would not contribute to ORD in MA 12. Alternative B would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. Because all new or opened roads in MA 12 associated with Alternative B would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 would not be necessary.

Although the new road prism in Alternative B would remain during transmission line operations, roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. New roads constructed for Alternative B could improve access for hunters on foot. During the final reclamation phase following mine

closure, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated.

Helicopter line-stringing, which would last about 10 days, could contribute to short-term displacement of individual deer from the transmission line corridor. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and overall deer populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities associated with decommissioning would cause similar disturbances.

Forage Openings

One opening in forest cover greater than 20 acres would be created by the Alternative B transmission line corridor. No point in the transmission line clearing area would be greater than 600 feet from cover.

Key Habitat Features

About 2 acres of wetlands providing water and high-quality forage would be impacted by Alternative B in the Crazy PSU (Table 164). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative B transmission line traversed or crossed the Howard, Libby, and Ramsey creek drainages. Alternative B could also interfere with deer movement in the Crazy PSU where it followed the ridge between Midas Creek and Howard Creek. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative B.

Impacts to White-tailed Deer on State and Private Lands

Alternative B would affect about 149 acres of white-tailed deer winter range on all lands in the analysis area, primarily in the Miller Creek drainage. Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in white-tailed deer winter range from transmission line construction would be minimized by restricting construction during the winter. Alternative B would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected. Short-term habitat

displacement could occur in the analysis area during transmission line construction as a result of helicopter use.

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife linkage zone in the Fisher River Valley. Impacts of Alternative B on white-tailed deer in the Fisher River Valley wildlife linkage zone would be the same as described for elk.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative C on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternative B (Table 164).

Open Road Density

Alternative C would include access changes (installation of barriers and gates and public access restrictions) for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD calculations.

In Alternative C, during line construction and operations, ORD in the Crazy PSU would be the same as existing conditions for MAs 12 and would decrease to 3.7 mi/mi^2 in MAs 15, 16, 17, and 18 (Table 165). In Alternative C, ORD in the Crazy PSU would continue to be worse than the KFP standard, although Alternative C would result in an improvement in ORD conditions in MAs 15, 16, and 17. Alternative C would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. Because all new or opened roads in MA 12 associated with the Alternative C would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 would not be necessary.

The status of new or opened roads associated with Alternative C would be the same as Alternative B, except that on National Forest System lands, the status of roads opened or constructed for transmission line access would be gated or barriered and placed in intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. The service roads would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. New transmission line roads on National Forest System lands would be decommissioned and revegetated after closure of the mine and removal of transmission line.

Although new roads would not result in increased motorized access, they could improve access for hunters on foot. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. Overall populations would not likely be affected. During the final reclamation phase following mine closure, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated.

Helicopter use could contribute to short-term displacement of individual deer from the transmission line corridor. Helicopter line stringing would occur during a relatively short period

(about 10 days). Helicopters also would be used in some segments for vegetation clearing and structure placement and the resulting disturbance could last up to 2 months. Vegetation clearing and structure placement where helicopters were used could contribute to short-term displacement of white-tailed deer, but overall deer populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after until decommissioning. Helicopter use and other activities associated with line decommissioning would cause similar disturbances with similar durations.

Forage Openings

New forage openings would be the same for Alternative C as Alternative B.

Key Habitat Features

About 3 acres of wetlands providing water and high-quality forage would be impacted by Alternative C in the Crazy PSU (Table 164). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative C transmission line traversed or crossed the Howard and Libby creek drainages. Alternative C could also interfere with deer movement in the Crazy PSU where it followed the ridge between Midas Creek and Howard Creek. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative C.

Impacts to White-tailed Deer on State and Private Lands

Alternative C would affect about 191 acres of white-tailed deer winter range on all lands in the analysis area, primarily in the Miller Creek and Fisher River drainages. Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in white-tailed deer from transmission line construction would be minimized by restricting construction during the winter. Alternative C would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of helicopter use.

A relatively small portion of the Alternative C transmission line would cross the Fisher River Valley in the wildlife linkage zone, potentially discouraging white-tailed deer movement in a

localized area due to transmission line construction activities. Impacts of Alternative C on white-tailed deer in the Fisher River Valley wildlife linkage zone would be the same as described for elk.

Alternative D – Miller Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative D on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternative C (Table 164).

Open Road Density

Impacts to ORD in the Crazy PSU would be the same for Alternative D as Alternative C, except that ORD in MA 12 would increase to 5.41 mi/mi^2 and ORD would increase to 3.8 mi/mi^2 during transmission line construction. All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23, which does not have an ORD standard. The reallocation of MA designations is described in section 3.14, *Land Use*. ORD in MA 12 would return to existing densities during transmission line operations.

Alternative D would include the same changes in road access described for Alternative C. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same as Alternative C.

The effects of vegetation clearing, structure placement, and line stringing would be the same for Alternative D as Alternative C.

Forage Openings

New forage openings would be the same for Alternative D as Alternative B.

Key Habitat Features

About 13 acres of wetlands providing water and high-quality forage would be impacted by Alternative D in the Crazy PSU (Table 164). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative D transmission line traversed or crossed the Howard and Libby creek drainages. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative D.

Impacts to White-tailed Deer on State and Private Lands

Impacts to white-tailed deer winter range from Alternative D would be the same as Alternative C, except that Alternative D would affect about 208 acres of white-tailed deer winter range on all lands in the analysis area, primarily in the Miller Creek and Fisher River drainages. Impacts of Alternative D on white-tailed deer in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative E on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternative C (Table 164).

Open Road Density

Impacts to ORD in the Crazy PSU would be the same for Alternative E as Alternative D. Alternative E would include the same changes in road access as described for Alternative C. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same as Alternative C. The effects of vegetation clearing, structure placement, and line stringing would be the same for Alternative E as Alternative C.

Forage Openings

New forage openings would be the same for Alternative E as Alternative B.

Key Habitat Features

Impacts to key habitat features would be the same for Alternative E as Alternative D.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative E transmission line traversed or crossed the Howard and Libby creek drainages. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative E.

Impacts to White-tailed Deer on State and Private Lands

Impacts to white-tailed deer winter range from Alternative E would be the same as Alternative C except that Alternative E would affect about 179 acres of white-tailed deer winter range on all lands in the analysis area, primarily in the Fisher River and Miller Creek drainages. Impacts of Alternative E on white-tailed deer in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Combined Mine-Transmission Line Effects

Impacts to white-tailed deer habitat in the analysis area from combined mine-transmission line alternatives are described below and shown in Table 166.

Cover/Forage

The combined mine-transmission line alternatives would not change the percent thermal cover in MAs 10 and 11. In general, the combined action alternatives would result in a decrease in percent cover relative to forage habitat. All combined action alternatives would result in a 1 percent decrease in cover relative to forage habitat in MAs 10 and 11 (Table 166). Alternative 2B would result in a 5 percent decrease in cover relative to forage habitat in summer range, while cover in summer range would fall by 4 percent in all other combined action alternatives. Alternatives 2B, 4C, 4D, and 4E would reduce cover in MAs 15, 16, and 17 by 3 percent, indicating that mine Alternatives 2 and 4 would have the greatest influence on cover in MAs 15, 16, and 17.

Open Road Density

Alternative 2B includes an access change in NFS road #4724 from April 1 to June 30 and the yearlong access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. The agencies' alternatives would include access changes (installation of barriers and gates and public access restrictions) for several roads to mitigate for the loss of big game security and impacts to grizzly bear (see section 2.5.7.3, *Wildlife Mitigation*). These changes in road access are taken into account in ORD calculations. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation.

Current ORD in MA 12 and MAs 15, 16, 17, and 18 in the Crazy PSU is higher than the standard (Table 167). Alternatives 3D, 3E, 4D, and 4E would increase ORD in MA 12 to 5.41 mi/mi^2 in the Crazy PSU during transmission line construction, but these increases in ORD would be temporary. Alternative 2B would increase ORD in MAs 15, 16, 17, and 18 in the Crazy PSU to 4.7 mi/mi^2 during construction and to 4.4 mi/mi^2 during operations, requiring a project-specific amendment to the KFP. Due to access changes (installation of barriers or gates and public access restrictions) associated with mitigation, the combined agencies' alternatives would decrease ORD in MAs 15, 16, 17, and 18 during transmission line construction and would decrease operations by 0.5 mi/mi^2 during construction and operations. For Alternative B, during transmission line operations ORD in MAs 15, 16, 17, and 18 would be 0.1 mi/mi^2 worse than existing densities. All action alternatives would include the reallocation of MA 12 in a 500-foot-wide corridor along the transmission line to MA 23. The reallocation of MA designations is described in section 3.14, *Land Use*. All new or opened roads in MA 12 associated with the combined action would be within the 500-foot corridor reallocated as MA 23, and would not require a KFP amendment to allow for increased ORD.

In all action alternatives, the new road prism would remain during transmission line operations. In the agencies' alternatives, roads would be placed into intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. The service roads would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. During the final reclamation phase following mine closure, all new roads would be removed, roads reclaimed, and all disturbed areas revegetated. For agencies' alternatives, roads would be decommissioned at mine closure.

Table 166. Impacts on White-tailed Deer Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Percent Cover/forage Summer Range[1]	96/4 (60/40)	91/9	92/8	92/8	92/8	92/8	92/8	92/8
Percent Cover/forage in MAs 10 and 11[2]	83/17 (70/30)	82/18	82/18	82/18	82/18	82/18	82/18	82/18
Percent Thermal Cover in MAs 10 and 11[2]	10 (>50)	10	10	10	10	10	10	10
Percent Cover in MAs 15, 16, and 17	86 (>30)	83	85	85	85	83	83	83
# Openings >20 acres in MAs 11 and 12[3]	6	8	8	8	8	8	8	8
Key Habitat Features Affected (acres)[4]	N/A	39	16	15	15	39	38	38
# Movement Areas Affected[5]	N/A	5	6	5	5	7	6	6
All Lands in Analysis Area								
White-tailed Deer Winter Range Impacted (acres)[6]	0	149	191	208	179	191	208	179

N/A = Does not apply.
Numbers in parentheses represent KFP standards or desired conditions.
Impacts shown are for the transmission line construction phase, which represents maximum estimated impacts.
[1] White-tailed deer summer range includes all MAs except MAs 10 and 11. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
[2] MAs 10 and 11 are managed for big game winter range; all MAs 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Transmission line corridor is counted as one opening. Other than the corridor length, no portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features, such as bogs and wet meadows, are represented by wetlands, as described in section 3.22, *Wetlands and Other Waters of the U.S.* Represents maximum impacts based on additive impacts of the combined mine-transmission line alternatives.
[5] Movement areas are represented by ridgelines of third order or larger drainages and riparian areas.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Table 167. Open Road Densities in the Crazy PSU by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
		TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
ORD in MA 12 (mi/mi^2)[3]	4.91 ($\leq$0.75)	4.91	4.91	4.91	4.91	5.41	4.91	5.41	4.91	4.91	4.91	5.41	4.91	5.41	4.91
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)[3]	4.3 ($\leq$3.0)	4.7	4.4	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during mine construction.
[2] Ops = during transmission line operations.
[3] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
ORD = open road density. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Overall, road densities would likely improve through MMC's or the agencies' grizzly bear land acquisition program, as described in sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve road densities where roads could be closed. The agencies' land acquisition program would likely be more effective at reducing road densities than MMC's proposed land acquisition program because more land would be protected.

Widening, improvement, and yearlong access of the Bear Creek Road could lead to increased vehicle volumes and speed, which could increase the risk of white-tailed deer mortality from vehicle collisions. Combined agencies' alternatives would include a transportation plan requiring that employees be bused to the work site, reducing the risk of white-tailed deer mortality from vehicle collisions. For the combined agencies' alternatives, wildlife mortality due to vehicle collisions would be monitored. If, in consultation with the FWP, wildlife mortality from road-killed animals were found to be excessive, mitigation measures would be developed to reduce mortality risks.

For all action alternatives, helicopter and other transmission line construction activities could result in short-term displacement of white-tailed deer from the transmission line corridor and surrounding habitat. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C above.

Forage Openings

In all combined action alternatives, two openings greater than 20 acres would be created. One opening greater than 20 acres in MAs 11 and 12 would be created along the Bear Creek Road near U.S. 2. Effects on white-tailed deer of this new opening would likely be minimal because no point would be more than 600 feet to cover, and due to its proximity to busy roads. No point in opening created by the transmission line clearing area would be greater than 600 feet from cover. The loss in forage capacity in these areas may impact individual white-tailed deer in the short term, until disturbed areas were successfully revegetated. Overall white-tailed deer populations would not likely be affected.

Key Habitat Features

Alternatives 2B, 4C, 4D, and 4E would have the greatest impacts on wetland habitat potentially providing water and high-quality forage for white-tailed deer in the Crazy PSU. Impacts of the other combined action alternatives on wetlands would be comparable, ranging from 15 acres for Alternatives 3D and 3E to 16 acres for Alternative 3C. Impacts to wetlands would be mitigated through implementation of the Wetland Mitigation Plan described in section 2.5.7.1, *Wetland Mitigation*. For the transmission lines, direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternatives 2B, 3D, and 3E would affect the fewest number of potential white-tailed deer movement areas. The agencies' alternatives could interfere with white-tailed deer movement where it followed the east-facing ridge north of the Sedlak Park Substation. Alternative 2B would be located at a lower elevation in the Fisher River valley and would not impact this area, but could affect white-tailed deer movement in the Ramsey Creek drainage. Alternatives 2B, 3C, and 4C could interfere with white-tailed deer movement where the transmission lines followed the

ridge between Midas Creek and Howard Creek. Potential white-tailed deer movement along the ridge between Miller Creek and Howard Creek could be affected by Alternatives 4C and 4D. White-tailed deer could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect white-tailed deer movement in this area after the construction phase because sufficient cover would be present.

White-tailed Deer Winter Range on All Lands

Impacts to white-tailed deer winter range from the combined action alternatives on all lands in the analysis area, including private and state lands, would range between 149 and 208 acres. Alternatives 3D and 4D would have the greatest impacts to white-tailed deer winter range, while Alternative 2B would have the fewest impacts to winter range. In all combined action alternatives, direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Impacts to white-tailed deer winter range would likely be minor in all combined action alternatives, relative to the total amount of winter range habitat available in the analysis area. Impacts to white-tailed deer winter range would be minimized through application of construction timing restrictions in white-tailed deer winter range. All combined action alternatives would result in increased road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of helicopter use.

Wildlife Linkage Zone

The eastern segment of the Alternative 2B transmission line corridor would occur within the wildlife linkage zone in the Fisher River Valley and relatively small segments of the transmission line corridors for all combined action alternatives would cross the Fisher River Valley in the wildlife linkage zone. The portions of the combined agencies' alternatives that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect white-tailed deer movement in the linkage zone. Impacts of the combined action alternatives on white-tailed deer in the Fisher River Valley wildlife linkage zone are the same as described for elk.

Cumulative Effects

Roads constructed in association with timber harvest, mining, and other development have cumulatively increased road densities in the analysis area. Development of private lands within the analysis area, including commercial timber harvest, land clearing, home construction, and road construction has contributed to increased disturbance of white-tailed deer and a loss or reduction in quality of white-tailed deer foraging and winter habitat, and is expected to continue. Fire suppression has resulted in the encroachment of conifers into foraging habitat and aging of shrub habitat.

Surface impacts from other reasonably foreseeable actions in the Crazy PSU would be minimal, and would not result in any measurable changes in cover or forage habitat; cover-to-forage ratios are not evaluated for cumulative effects on white-tailed deer.

New roads and roads closed for mitigation associated with reasonably foreseeable actions, including the Wayup Mine/Fourth of July Road Access Project, will contribute to cumulative effects on ORD in the Crazy PSU. The No Action alternatives (Alternative 1 and Alternative A) would not contribute to cumulative impacts on white-tailed deer. Cumulative impacts of the combined mine-transmission line alternatives, in combination with other reasonably foreseeable actions, on ORD in the Crazy PSU are shown in Table 168. Because none of the action alternatives would increase road densities in the Crazy PSU in MA 12, they would not contribute to cumulative road densities in MA 12; ORD in MA 12 is not displayed.

Open Road Density

Reasonably foreseeable actions, including the Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Rock Creek Project, and the Miller-West Fisher Vegetation Management Project, would not contribute to cumulative ORD in MA 12, and any changes in ORD in MA 12 would be due to the proposed Montanore Project. Due to road access changes associated with reasonably foreseeable actions, cumulative impacts in all agencies' alternatives would result in reductions in ORD in MAs 15, 16, 17, and 18 in the Crazy PSU both during and after transmission line construction. For Alternative B, despite road access changes associated with other projects, ORD in MAs 15, 16, 17, and 18 in the Crazy PSU would increase to 4.5 mi/mi^2 during transmission line construction, but would be better than existing densities after the transmission line was built. In all combined action alternatives, cumulative ORD would remain greater than KNF standards in MA 12 and MAs 15, 16, 17, and 18.

Forage Openings

Only a few openings greater than 20 acres would be created in the Crazy PSU as a result of the action alternatives. Surface impacts from other reasonably foreseeable actions in the Crazy PSU would be minimal, and would not result in any new openings greater than 40 acres.

Key Habitat Features

All action alternatives would result in the disturbance of wetlands providing potential water and high-quality forage habitat for white-tailed deer in the Crazy PSU. Impacts to wetlands would be mitigated through implementation of the Wetland Mitigation Plan. Other reasonably foreseeable actions would contribute to losses of wetland habitat. Impacts to wetlands from reasonably foreseeable actions would require mitigation under the Clean Water Act.

Movement Areas

The mine action alternatives could interfere with white-tailed deer movement in the Little Cherry, Poorman, and Libby creek corridors. The transmission line alternatives could affect white-tailed deer movement where the lines traversed or crossed the Howard and Libby creek drainages. Alternative B could also disrupt movement in the Ramsey Creek corridor. Disturbance-related impacts from transmission line construction would be short-term and the width of clearing area would not likely be great enough to affect deer movement after the construction phase. Other reasonably foreseeable actions could impede deer movement in specific areas due to increased road use and noise disturbance, but KNF riparian standards would minimize activities in riparian areas. While some cumulative effects to white-tailed deer movement could occur, they would likely be minimal.

Table 168. Cumulative Impacts to Open Road Densities in the Crazy PSU by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] Existing Condition	[1] No Mine[1]	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
			TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
			Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]	Const[2]	Ops[3]
ORD in MA 12 (mi/mi^2)[4]	4.91 (≤0.75)	4.91 (<0.75)	4.91	4.91	4.91	4.91	5.41	4.91	5.41	4.91	4.91	4.91	5.41	4.91	5.41	4.91
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	4.3 (≤3.0)	4.1 (<3.0)	4.5	4.2	4.2	3.8	4.2	3.8	4.2	3.8	4.2	3.8	4.2	3.8	4.2	3.8

Numbers in parentheses represent KFP standards or desired conditions.
[1] Effects shown include effects of the Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Rock Creek Project, and the Miller-West Fisher Vegetation Management Project. Alternative 1 (No Transmission Line) would not contribute to cumulative effects on ORD.
[2] Const = during mine construction.
[3] Ops = during transmission line operations.
[4] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23. MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*.
ORD = open road density.
Source: GIS analysis by ERO Resources Corp. using KNF data.

White-tailed Deer Winter Range on All Lands

All combined action alternatives, in combination with other reasonably foreseeable actions, especially the Miller-West Fisher Vegetation Management Project, would result in cumulative impacts to white-tailed deer winter range on all lands in the analysis area, resulting in a reduction of thermal and hiding cover and, once disturbed areas were revegetated, an increase in forage habitat. Cumulative impacts of all combined action alternatives would likely be minor because application of construction timing restrictions in winter range would minimize impacts. The combined action alternatives, in combination with Plum Creek activities, could result in cumulative disturbance to white-tailed deer on private lands in the analysis area, and could displace white-tailed deer away from areas of disturbance. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected.

3.24.3.3.4 Regulatory/Forest Plan Consistency

KFP. During transmission line construction and operations, all combined action alternatives would change ORD in the Crazy PSU in MAs 15, 16, 17, and 18, where ORD is currently greater than the KFP standard. Alternative B would increase ORD in the Crazy PSU in MAs 15, 16, 17, and 18. Although the agencies' alternatives would improve ORD in the Crazy PSU in MAs 15, 16, 17, and 18, they would not decrease ORD to meet KFP standards. A KFP amendment allowing ORD greater than the KFP standard in the Crazy PSU in MAs 15, 16, 17, and 18 would be required for all combined action alternatives. With the incorporation of the KFP amendment, all combined action alternatives would meet all KFP direction for general forest MIS species (KFP Vol. 1, II-22 #3, III-45 #8 and III-49 #7).

All action alternatives would result in cover-to-forage ratios in the Crazy PSU closer to recommended ratios. ORD in the Crazy PSU currently exceeds the KFP standard in MA 12. Alternatives 3D, 3E, 4D, and 4E would contribute to ORD in MA 12 in the short term during transmission line construction. All combined action alternatives would include a project-specific amendment to the KFP to change all MAs 10, 11, and 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment is for the duration of the proposed Montanore Project. KFP amendments have been discussed section 3.14.4, *Environmental Consequences*. All new or opened roads in MA 12 associated with the transmission line would be within the 500-foot corridor reallocated as MA 23.

State Management. White-tailed deer and other ungulate populations are managed by FWP. Proposed actions would not prevent the state from continuing to manage these species as harvestable populations.

Summary General Forest MIS Statement. Based on the white-tailed deer analysis and the KNF Conservation Plan (Johnson 2004a), all combined mine-transmission line alternatives should provide general forest species habitat with sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all combined mine-transmission line alternatives, sufficient general forest habitat should be available; the populations of species using that habitat should remain viable.

3.24.3.4 Mountain Goat

3.24.3.4.1 Analysis Area and Methods

The mountain goat is the KNF MIS for alpine habitat. Mountain goat ecology, biology, habitat use, status, and conservation are described and summarized in Joslin (1980) and Brandborg

(1955). That information is incorporated by reference. Mountain goat occurrence data come from District wildlife observation records and Forest historical data (NRIS FAUNA) and other agencies (FWP).

Habitat mapping for mountain goat is derived from Joslin (1980), and is categorized according to Management Situation (MS 1, 2, or 3) and seasonal use (winter, summer, or transitional range). MS 1 areas are critical mountain goat range, as documented with numerous observations. MS 2 areas are where few observations of mountain goats have been recorded. MS 2 areas do not currently support goat populations, although they may have in the past, and they appear to have all the features of suitable habitat. MS 3 areas are not known to provide important goat habitat, but because of their juxtaposition to MS 1 and MS 2 areas, it would not be unusual to observe goats in these areas. Habitat categories are defined in Joslin (1980). MS 1 areas are regularly used by mountain goats during one or more seasons and goats in these areas are more sensitive to human impacts and activity (Joslin 1980).

Mountain goats have been shown to be sensitive to human disturbances such as helicopter use, blasting, and road building (Joslin 1980). Increased disturbance may result in displacement from suitable habitat. Mountain goats may also remain in proximity of the disturbance, potentially suffering increased stress levels that could result in a decline in reproductive rates (ibid.). Distances at which goats may be affected by such disturbance are not known. In absence of species-specific data, the influence zones suggested for grizzly bear in the Cumulative Effects Model (USDA Forest Service 1988a) were used to estimate the displacement effects of disturbances associated with mine and transmission line construction and operations on mountain goats.

Effects of the alternatives were evaluated based on impacts to mountain goat habitat. The analysis area for project impacts to individuals and their habitat includes all mountain goat habitat in the Crazy, Silverfish, Bull, Rock, and Green PSUs (Figure 88). This zone includes the year-round area occupied by mountain goats in the southern Cabinet Mountains. The boundary for cumulative effects is the KNF and the FWP Mountain Goat HD 100. Mountain goat habitat does not occur on private land within the zone of influence of the proposed project.

The impacts analysis includes an evaluation of the potential benefits to mountain goats from mitigation measures proposed by MMC or the agencies, such as funding for monitoring of mountain goat responses to mine-related impacts, prohibiting blasting at adit portals between June 1 and June 30, access changes, land acquisitions, and prohibiting employees from carrying firearms.

3.24.3.4.2 Affected Environment

Mountain goats are found primarily in alpine habitat and high elevation coniferous forest stands throughout the year. Goats annually use the same summer and winter ranges, travel corridors, kidding areas, and mineral licks, and rarely explore new territory, which make them vulnerable to human activities or habitat changes in their range (Joslin 1980). Habitat use information and traditional use patterns are learned behaviors passed down through generations. If traditional use patterns are altered and seasonal home range knowledge is not transferred to offspring, then suitable ranges may not be recolonized (ibid.). Mountain goats use steep rock outcrops and escarpments for escape from predators and security during the kidding period, and feed on vegetation found in the rock crevices. They use coniferous timber as shelter from severe weather, particularly during winter. Mountain goats eat a wide variety of foods, but in the Cabinet

Mountains, shrubs are the major component of their diet year-round. Grasses are also consumed when available. In winter, goats browse on trees (Joslin 1980).

Mountain goat winter range is usually found in spruce-fir forests that are characterized by 80 percent slopes, average snow depths of less than 20 inches, or where the terrain extends to areas of lower elevation with an average snow depth less than 20 inches. During the winter, mountain goats usually forage on shrubs and trees. During mild winters, mountain goats have been known to travel between several winter areas (Joslin 1980). About 6,800 acres of confirmed winter range was mapped in the Cabinet Mountain range in 1980. An additional 21,000 acres of probable and possible winter range were mapped in the East and West Cabinet Mountains during the 1979 and 1980 study by Joslin (ibid.).

The analysis area contains about 151,208 acres of mountain goat habitat (Table 169), including 60,224 acres of winter range MS 1 habitat. During the 1988–1989 environmental studies, most goats in the area wintered in Rock Creek, but two were observed above Libby Creek and one above Ramsey Creek (Western Resource Development 1989f). FWP has identified the area above Rock Creek as confirmed winter range; the south-facing slopes above upper West Fisher Creek as probable winter range; and south-facing slopes above Libby, Ramsey, and Poorman creeks as possible winter range (Joslin 1980).

Historical population numbers were estimated to be 350 goats in the Cabinet Mountains in 1950, declining to between 95 and 160 in 1980 (Casebeer *et al.* 1950; Joslin 1980). About 88 goats were counted during FWP standardized sampling surveys of HD 100 (Cabinet Mountains) during spring 2008, which is greater than the average of 65 goats counted (FWP 2008c). About 24 percent of the goats observed in 2008 were kids, corresponding to an average rate of reproduction (ibid.). During surveys conducted in 1988 and 1989, 40 to 55 mountain goats were estimated to occupy rocky ridges in portions of the analysis area (Western Resource Development 1989f). During all seasons, most of the activity was in and near the headwalls of the Rock, Libby, and West Fisher creek drainages, but some solitary males were observed in the Ramsey and Poorman creek areas. The closest documented wintering area on the east side of the Cabinet Mountains was on the south-facing slope of Shaw Mountain in Libby Creek. Two goats were seen in this area in 1989 (ibid.), which is about 0.5 mile north of the Libby Adit site. More recent observations by FWP personnel indicate that Libby, Ramsey, West Fisher, Poorman, and Rock creeks represent a population epicenter for mountain goats in the southern Cabinet Mountains (Brown, pers. comm. 2008).

Mountain goat breeding occurs primarily in November (Joslin 1980). During the breeding season, mountain goats are primarily observed in the project vicinity in the Libby, Ramsey, and West Fisher creek drainages (Brown, pers. comm. 2007).

Summer transitional mountain goat habitat provides high-quality forage areas within high elevation coniferous forests and rock outcrops. Although winter range appears to be the limiting factor to goat densities in the Cabinet Mountains, quality summer range is also of paramount importance in providing highly nutritious forage, which fortifies the body for winter and sustains the population from year-to-year (Joslin 1980). Ridgelines are commonly used as travel corridors between summer transitional habitat (ibid.). About 63,688 acres of summer transitional MS 1 habitat occurs in the analysis area.

Mountain goats generally give birth to their kids in late May or early June on lower slopes at the mouth of drainages (Joslin 1980). The areas around Shaw Mountain and Leigh Lake appear to be important for mountain goat kidding (Brown, pers. comm. 2005, 2008).

3.24.3.4.3 Environmental Consequences

Physical impacts to mountain goat habitat from the mine alternatives would be greatest for Alternative 2, which would affect 151 acres, due to the Ramsey Plant Site. Alternatives 3 and 4 would directly impact 98 acres of mountain goat habitat. Alternative 1 would have no direct impacts on mountain goats.

Impacts to mountain goats from the transmission line alternatives are shown in Table 169 and described in the following subsections. The analysis of the effects of human activity on goats is based on activity-specific buffers, and includes the effects of open roads. Road access changes associated with mitigation were determined for combined action alternatives. It is not possible to attribute these access changes to individual mine and transmission line alternatives independent of one another. Because the disturbance buffer applied to new or opened roads associated with the transmission line is encompassed entirely by the buffer applied for helicopter disturbance, human disturbance effects for transmission line construction are calculated based on the area of overlap between the helicopter disturbance buffer and mountain goat habitat. It is assumed that human activity would not affect mountain goats during transmission line operations. The evaluation of the effects of human activity on mountain goats from individual mine alternatives may be inferred from impact calculations for the combined mine-transmission line alternatives shown in Table 170.

Table 169. Mountain Goat Habitat Affected by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line/Existing Conditions (acres)	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative) (acres)		[C] Modified North Miller Creek Transmission Line Alternative (acres)		[D] Miller Creek Transmission Line Alternative (acres)		[E] West Fisher Creek Transmission Line Alternative (acres)	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Mountain Goat Habitat Available (acres)	151,208	151,161 (-47)	151,161 (-47)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)
Habitat Affected by Human Activity[3, 4] (acres)	8,303	12,180 (+3,877)	8,303 (0)	8,927 (+624)	8,303 (0)	9,032 (+729)	8,303 (0)	9,032 (+729)	8,303 (0)

Number in parentheses is the change in habitat acres due to the alternative compared to existing conditions.
[1]Const = during transmission line construction.
[2]Ops = during transmission line operations
[3]Acres affected by human activity do not include areas of overlap from different sources of disturbance. Disturbance effects were calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter use = 1 mile on each side of disturbance.
[4] For Alternative B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used for vegetation clearing or structure placement for Alternative B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data derived from Joslin 1980.

Table 170. Mountain Goat Habitat Affected by Combined Mine-Transmission Line Alternative.

Habitat Component	[1] No Mine Existing Condition	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
	TL-A	TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Mountain Goat Habitat Available (acres)	151,208	151,010 (-198)	151,010 (-198)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)	151,110 (-98)
Habitat Affected by Human Activity[3,4] (acres)	8,303	16,092 (+7,789)	10,994 (+2,691)	13,870 (+5,567)	10,818 (+2,515)	13,956 (+5,656)	10,818 (+2,515)	13,956 (+5,656)	10,818 (+2,515)	13,870 (+5,567)	10,818 (+2,515)	13,956 (+5,656)	10,818 (+2,515)	13,956 (+5,656)	10,818 (+2,515)

Numbers in parentheses is the change in habitat acres due to the alternatives compared to existing conditions.
[1] Const = during project construction.
[2] Ops = during project operations.
[3] Acres of disturbance do not include areas of overlap from different sources of disturbance. Disturbance effects were calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter construction = 1 mile on each side of disturbance.
[4] For Alternative 2B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used during vegetation clearing or structure placement for Alternative 2B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data derived from Joslin 1980.

Alternative A – No Transmission Line

Alternative A would have no impacts on mountain goat habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would result in the physical disturbance of about 47 acres of mountain goat habitat, due to disturbance in the transmission line clearing area in Ramsey Creek (Table 169). During the construction phase, Alternative B would result in additional short-term disturbance to about 3,877 acres of goat habitat, primarily due to helicopter line stringing in the Ramsey Creek area. Line stringing conducted by helicopter could displace goats from suitable habitat or reduce their ability to effectively use the available habitat in the short term. Individual goats could suffer increased stress levels from disturbance during helicopter line stringing, but these impacts would last no more than 10 days and would not likely affect goat populations. Disturbance effects could also occur from other transmission line construction activities in areas where helicopters were not used. Except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of mountain goats during line decommissioning.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would have no physical impacts on mountain goat habitat (Table 169). Line stringing conducted by helicopter could displace goats temporarily from suitable habitat or reduce their ability to effectively use the available habitat. Helicopter construction would not occur in proximity to mountain goat habitat, and is not expected to affect mountain goats. Alternative C would have less effect on mountain goats than Alternative B. During the construction phase, Alternative C would result in increased short-term disturbance to about 624 acres of goat habitat, primarily due to helicopter line stringing at the mouth of upper Libby Creek. Individual goats could suffer increased stress levels from disturbance during helicopter line stringing, but these impacts would last no more than 10 days and would not likely affect goat populations. In Alternative C, except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Impacts of Alternative D on mountain goats would be the same as Alternative C, except that Alternative D would result in slightly more human disturbance than Alternative C. During the construction phase, Alternative D would result in additional short-term disturbance to about 729 acres of goat habitat.

Alternative E – West Fisher Creek Transmission Line Alternative

Impacts of Alternative E on mountain goats would be the same as Alternative D.

Combined Mine-Transmission Line Effects

Impacts of the combined mine-transmission line alternatives are shown in Table 170 and described below.

Alternative 2B would result in direct losses of about 198 acres of mountain goat habitat, mostly due to disturbance from the Rock Lake Ventilation Adit and Ramsey Plant Site (Table 170). Less

goat habitat would be lost or disturbed by the combined agencies' alternatives because the adits and plant site would be located in the same drainage (*i.e.*, Libby Creek). All combined agencies' alternatives would physically disturb about 98 acres of goat habitat.

Disturbance effects from human activity would have a much greater impact on the mountain goat than physical impacts to goat habitat, and would include disturbance from activities associated with blasting, construction of the plant and adit sites, road construction and use, plant and adit operations, and helicopter use that could displace goats from suitable habitat or reduce their ability to effectively use the available habitat. Disturbance from helicopter use and other transmission line construction activities are described above for the transmission line alternatives. Disturbance from blasting during mine construction could result in habitat displacement and increased stress levels for mountain goats, but would be short-term. Blasting would likely be mostly underground at the Libby Adit, where a maximum of two rounds of blasting would occur at the surface. The Ramsey Adits would probably require a maximum of two rounds of surface blasting per adit. The ventilation raise would be constructed from inside the mine and would not require any surface blasting, except for creation of the surface opening. Construction of the Ramsey Adits for Alternative 2B and the lower and upper Libby Adits for the combined agencies' alternatives is expected to take about 1 year. The construction phase in all combined action alternatives is expected to last 2 to 3 years. Noise and human activity associated with plant construction could also cause goats inhabiting surrounding areas to move to other portions of their home range for the duration of construction activities. Goats could suffer increased stress levels from disturbance during construction and operations that could result in a decline in reproductive rates.

During the construction phase, Alternative 2B would result in the most additional human disturbance to goat habitat, affecting about 7,789 acres. Human disturbance impacts from Alternative 2B would be greater than the combined agencies' alternatives due to helicopter line stringing, plant construction, and adit construction in Ramsey Creek. Less goat habitat would be disturbed by combined agencies' alternatives because the adits and plant site would be located in the same drainage (*i.e.*, Libby Creek), and because the transmission line would end at the mouth of Libby Creek. The agencies' alternatives would result in additional disturbance to between 5,567 acres and 5,653 acres during project construction. For the combined agencies' alternatives, no blasting would occur at the adits from June 1 to June 30, which would minimize disturbance to the potential goat kidding area on Shaw Mountain. The combined agencies' alternatives also would include funding for monitoring of mountain goat responses to mine-related impacts. If, in consultation with the FWP, mine disturbance were found to have a substantial impact on goat populations, mitigation measures would be developed to reduce the impacts of mine disturbance.

During mine operations, additional disturbance to goat habitat would range from 2,515 acres for the combined agencies' alternatives to 2,691 acres for Alternative 2B. Long-term disturbance to mountain goats during operations, such as noise and human activity, could cause goats to experience increased stress levels or to move from currently inhabited surrounding areas to other portions of their home range.

Most disturbances to goats would be short-term, and long-term disturbance would increase on a relatively small proportion (less than 0.01 percent) of goat habitat in the analysis area. In all combined action alternatives, some disturbance effects would be offset by access changes (installation of gates or barriers and public access restrictions) and habitat acquisitions planned as mitigation for the impacts to grizzly bear and big game security. Acquired parcels would be

managed for grizzly bear use in perpetuity, and could improve or contribute suitable mountain goat habitat if the acquired parcels provided appropriate habitat characteristics and could be managed to improve mountain goat habitat. The combined agencies' alternatives would include more road access changes and habitat acquisition, and would more effectively mitigate potential effects of disturbance to mountain goats. Of the 50 parcels identified as potential replacement habitat for mitigating the effects of the proposed project, 11 may provide mountain goat habitat. The combined mine-transmission line alternatives are not anticipated to result in the loss of goat herd occurrence or abundance in the southern Cabinet Mountains. In all combined action alternatives, the risk of mountain goat mortality would increase as a result of increased access to mountain goat habitat.

Cumulative Effects

Neither Alternative 1 nor Alternative A would cumulatively impact mountain goats. Mineral exploration has occurred and would continue to occur throughout the Cabinet Mountains, cumulatively displacing goats from suitable habitat or reducing their ability to effectively use the available habitat. Disturbance impacts to mountain goats from the combined action alternatives would be compounded when impacts from other reasonably foreseeable actions are taken into account. The Wayup Mine/Fourth of July Road Access Project, the Rock Creek Project, and the Bear Lakes Access Project would collectively influence about 4,561 acres of MS 1 goat habitat, potentially resulting in this habitat becoming less desirable or less effective for mountain goats.

Some of the disturbance associated with construction of the proposed project and other reasonably foreseeable actions, such as blasting and helicopter line stringing and construction, would be short-term. Noise generated by construction and blasting for the evaluation adits for the Rock Creek Project would occur sporadically for several weeks. Underground blasting would be considered after the adit reaches a depth of about 500 feet at the Rock Creek site, based on experience at the Troy Mine adit. If surface blasting and other construction activities occurred concurrently for the Rock Creek and Montanore projects, cumulative noise disturbance could result in habitat displacement and increased stress levels for mountain goats.

While cumulative disturbance impacts to goats would be mostly short-term, disturbance during project operations, such as noise and human activity, would be long-term. Road access into critical goat habitat is the single biggest threat to goats in the Cabinet Mountains (Joslin 1980), and the Fourth of July proposal would construct a new road to the edge of the Cabinet Wilderness and MS 1 habitat. Cumulative long-term disturbance to mountain goats could result in changes in seasonal habitat use, potentially causing goats to shift their use of habitat in Ramsey Creek (Alternative 2B only), Libby Creek (all combined action alternatives), upper West Fisher Creek and Rock Creek basins. These potential changes in seasonal habitat use could increase the use of unaffected summer ranges creating potential conflicts with resident goats in the CMW. The cumulative disturbance effects of the mine alternatives and other reasonably foreseeable actions could result in reduced reproductive rates and a decrease in population of the Rock Creek herd. Some cumulative human-caused disturbance effects would be offset by road access changes (installation of barriers and gates and public access restrictions) and habitat acquisitions planned as mitigation for the Montanore, Rock Creek, and other projects.

3.24.3.4.4 Regulatory/Forest Plan Consistency

KFP. The KFP does not provide specific direction for mountain goats. In all combined mine-transmission line alternatives, adequate amounts of mountain goat habitat would continue to be

provided for mountain goats. All combined mine-transmission line alternatives would be consistent with KFP direction on MIS (KFP Vol. I, II-1 #3 and #7).

Summary Alpine Forest MIS Statement. Based on the analysis for mountain goat and the KNF Conservation Plan (Johnson 2004a), in all action alternatives, habitat for alpine forest species would be provided in sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all action alternatives, sufficient alpine habitat would be available; the populations of species using that habitat should remain viable.

3.24.3.5 Pileated Woodpecker

3.24.3.5.1 Analysis Area and Methods

The pileated woodpecker is a MIS for old growth and snag habitat in the KNF. Old growth habitat is optimal for pileated woodpecker, providing both nesting habitat and year-round foraging habitat (Thomas 1979). Large diameter snags characteristically found in old growth forests provide nesting habitat for the pileated woodpecker, while both the snags and coarse woody material provide habitat for the woodpecker's primary prey species, the carpenter ant (Warren 1990).

Pileated woodpecker population ecology, biology, habitat description, and relationships in the northern Rocky Mountains are described in McClelland and McClelland (1999), McClelland (1979, 1977), McClelland *et al.* (1979), and Warren (1990). This information is incorporated by reference. Research conducted in the Pacific and Inland Northwest is described in Bull and Jackson (1995), Bull and Holthausen (1993), Bull *et al.* (1992b), Bull (1987, 1980, 1975), Bull and Meslow (1977), Mellen *et al.* (1992), Mellen (1987), Thomas (1979), Mannan (1977), and Jackman (1974).

Pileated woodpecker occurrence data come from recent District wildlife observation records, the Region One Landbird Monitoring Program (Avian Science Center, University of Montana), and Forest historical data (NRIS FAUNA). Potential habitat for this species on National Forest System land was estimated using all designated and undesignated old growth habitat and old growth replacement habitat that has been mapped for the KNF. On private land, potential pileated woodpecker habitat is based on old growth mapping, as described in section 3.21, *Vegetation*.

Effects of the alternatives were evaluated based on impacts to important attributes of pileated woodpecker habitat, primarily designated and undesignated old growth habitat, and the estimated number of pileated woodpeckers potentially supported in the analysis area. Availability of down wood and snag habitat, and the effects of habitat fragmentation and increased edge habitat was also evaluated. Specific features of old growth stands evaluated for project impacts on the pileated woodpecker include preferred nest tree species, preferred nest tree size, down logs (both size and quantity), basal area, and canopy closure.

The assessment of habitat quality also includes the evaluation of fragmentation, edge effect, and interior habitat discussed in section 3.21.2, *Old Growth Ecosystems*. Potential impacts of firewood cutting are also evaluated. Stands that are not designated as old growth but that may have one or more important attributes of old growth forests, or perhaps provide for connectivity and interior habitat, also were reviewed as part of this analysis.

The number of pileated woodpeckers potentially supported, referred to as potential population index (PPI), in the analysis area was estimated based on methods described in Johnson (2003).

The PPI was determined by dividing habitat acres by average home range sizes derived from McClelland (1977), Thomas (1979), Mellen *et al.* (1992), and Bull and Holthausen (1993). Research suggests that fewer acres of higher quality habitat are required to support a breeding pair of pileated woodpeckers (McClelland 1977; Mannan *et al.* 1980; Bull and Holthausen 1993). Also, allowing for larger territory sizes as habitat becomes fragmented appears reasonable, as territory sizes up to 2,600 acres have been reported for western Oregon (Mellen *et al.* 1992). Thus, the PPI in the KNF and the analysis area was calculated based on one nesting pair per 600 acres of effective old growth habitat and one nesting pair per 1,000 acres of replacement old growth habitat. The PPI was calculated based on the assumption that all currently mapped effective and replacement old growth habitat (both designated and undesignated) provides suitable nesting habitat, and that all suitable habitat is spatially distributed across the landscape in a pattern that can be incorporated into individual nesting territories.

The analysis areas for project impacts to individuals and their habitat in the KNF are the Crazy and Silverfish PSUs. The analysis area for evaluating direct and indirect impacts of the transmission line on pileated woodpeckers on private and state land consists of all non-National Forest System lands that would be disturbed by any of the transmission line alternatives. The KNF and any non-National Forest System lands potentially disturbed by the transmission line alternatives is the analysis area for cumulative effects.

The impacts analysis includes an evaluation of the potential benefits to pileated woodpeckers from mitigation measures proposed by MMC or the agencies, such as designation of old growth-associated with the agencies' proposed old growth mitigation and land acquisitions.

3.24.3.5.2 Affected Environment

Based on existing old growth (see section 3.21, *Vegetation*), the estimated minimum PPI for the pileated woodpecker on the KNF is 430 nesting or breeding pairs. This is within the calculated historical range of variation (HRV) for the minimum potential population index of 335 to 554 breeding pairs (Johnson 1999).

A detailed summary of old growth habitat for the Crazy and Silverfish PSUs is provided in section 3.21, *Vegetation*. The Crazy PSU contains about 8,620 acres of effective old growth habitat (both designated and undesignated), and the Silverfish PSU contains about 5,271 acres of effective old growth habitat (both designated and undesignated). The Crazy PSU contains about 477 acres of replacement old growth habitat (both designated and undesignated), and the Silverfish PSU contains about 1,361 of replacement old growth habitat (both designated and undesignated). Existing pileated woodpecker nesting territories likely encompass a significant portion of this old growth habitat. Based on the quantity of old growth habitat available, the Crazy PSU could support about 12 nesting territories (PPI) and the Silverfish PSU could support about 11 nesting territories (PPI).

Snags and down wood provide food resources such as carpenter ants and their larvae, one of the primary prey items for pileated woodpeckers in the Northern Rockies (McClelland and McClelland 1999; McClelland 1977) and in the Pacific and Inland Northwest (Bull *et al.* 1992a; Bull 1987, 1975; Bull *et al.* 1980). Existing snag densities and amounts of down wood in the Crazy and Silverfish PSUs are greater than KFP-recommended levels. Existing conditions for snag habitat and down wood are described in section 3.24.2, *Key Habitats*.

No population data are available for pileated woodpeckers within the KNF. During breeding bird point count surveys conducted from 1994 to 2004 on the KNF, the pileated woodpecker was observed 204 times at the 2,638 individual survey points (USDA Forest Service 2003b). Point count surveys are not designed to census woodpecker species and may not accurately reflect pileated woodpecker populations. No pileated woodpeckers were observed during breeding bird surveys conducted in 2005 at the Little Cherry Creek Tailings Impoundment Site, the Ramsey Plant Site, the LAD Areas, and MMC's proposed transmission line alignment (Westech 2005a). Searches for active pileated woodpecker nest cavities also were conducted during old growth validation surveys in 2007, but none were found (see KNF project record).

Potential pileated woodpecker habitat on private and state lands within the analysis area consists primarily of riparian old growth and occurs mainly in the Fisher River, West Fisher Creek, and Hunter Creek riparian corridors.

3.24.3.5.3 Environmental Consequences

The following section discusses the direct, indirect, and cumulative effects on pileated woodpeckers for each of the mine alternatives, transmission line alternatives, and combined mine-transmission line alternatives. Impacts to pileated woodpecker in the Crazy and Silverfish PSUs from the mine and transmission line alternatives are summarized in Table 171 and Table 172 and described below.

Alternative 1 – No Mine

In Alternative 1, natural successional processes would continue to occur throughout old growth stands and habitat would continue to be provided for pileated woodpecker nesting pairs where feeding and breeding conditions are suitable. There would be no direct or indirect impacts to pileated woodpecker (old growth habitat) from Alternative 1, and no change in PPI (Table 171).

Replacement old growth habitat currently provides less suitable stand conditions for territory occupation. Over the next several decades, in the absence of catastrophic fires or windstorms, these stands would develop habitat features suitable for pileated woodpeckers such as larger trees, larger snags, more down logs, and more dead and dying trees that provide food resources such as carpenter ants and their larvae.

In Alternative 1, continued disruption of the historical pattern of frequent fires in the drier ponderosa pine/Douglas-fir cover type would result in ecological changes, such as the encroachment of Douglas-fir saplings in the understory. Eventually, these sites would develop a higher percentage of Douglas-fir trees, snags, and down logs more suitable as foraging habitat for pileated woodpeckers. This successional trend may result in a reduction in quality pileated woodpecker nest trees (ponderosa pine) since Douglas-fir was not found to be important for pileated woodpecker nest cavity excavation in the northern Rocky Mountains (McClelland and McClelland 1999; McClelland 1977; Weydemeyer and Weydemeyer 1928), in northeast Oregon (Bull 1987, 1975; Thomas 1979), or in British Columbia (Harestad and Keisker 1989).

Table 171. Effects on Potential Pileated Woodpecker Habitat and Population Index by Mine Alternative.

Analysis Area	[1] No Mine/ Existing Con-ditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impound-ment Alternative	[4] Agency Mitigated Little Cherry Creek Impound-ment Alternative
Crazy PSU				
Unmitigated Effects				
Effective OG (acres)	7,206	6,902 (-304)	7,026 (-180)	7,034 (-172)
Replacement OG (acres)	239	236 (-3)	236 (-3)	236 (-3)
PPI	12	12	12	12
Mitigated Effects				
Total old growth designated (acres)[1]	0	0	587	659
PPI with mitigation[2]	12	12	13	13
KNF				
Unmitigated Effects				
Effective OG (acres)	199,109	198,805 (-304)	198,929 (-180)	198,937 (-172)
Replacement OG (acres)	98,064	98,061 (-3)	98,061 (-3)	98,061 (-3)
PPI	430	430	430	430
Mitigated Effects				
PPI with mitigation[2]	430	430	431	431

OG = old growth.
Number in parentheses is the reduction in habitat acres due to the alternative compared to Alternative 1 No Mine/Existing Conditions.
Mine alternatives would not impact potential pileated woodpecker habitat (old growth) in the Silverfish PSU and are not shown.
[1] Old growth designated to mitigate impacts to old growth. See section 3.21, *Vegetation* for a more detailed description of old growth mitigation.
[2]PPI with mitigation is based on the assumption that old growth is designated in association with mitigation provides replacement old growth.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 172. Effects on Potential Pileated Woodpecker Habitat and Population Index by Transmission Line Alternative.

Analysis Area and Indicator	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative) (Change from Existing Conditions)	[C] Modified North Miller Creek Transmission Line (Change from Existing Conditions)	[D] Miller Creek Transmission Line (Change from Existing Conditions)	[E] West Fisher Creek Transmission Line (Change from Existing Conditions)
Crazy PSU[1]					
Unmitigated Effects					
Effective OG (acres)	7,206	7,183 (-23)	7,198 (-8)	7,193 (-13)	7,193 (-13)
Replacement OG (acres)	239	239 (0)	239 (0)	239 (0)	239 (0)
PPI	12	12	12	12	12
Crazy and Silverfish PSUs					
Mitigated Effects					
Total old growth designated (acres)[2]	0	0	39	64	64
Combined Crazy and Silverfish PPI[2]	23	23	23	23	23
KNF					
Unmitigated Effects					
Effective OG (acres)	199,109	199,086 (-23)	199,101 (-8)	199,096 (-13)	199,096 (-13)
Replacement OG (acres)	98,064	98,064 (0)	98,064 (0)	98,064 (0)	98,064 (0)
PPI	430	430	430	430	430
Mitigated Effects					
PPI with mitigation[3]	430	430	430	430	430
Private Land					
Old growth removed (acres)	0	4	2	2	6

See footnotes on next page.

OG = old growth.
Number in parentheses is the reduction in habitat acres due to the alternative compared to Alternative A, No Transmission Line/Existing Conditions.
[1] Impacts of the transmission line alternatives on potential pileated woodpecker habitat (old growth) in the Silverfish PSU would be limited to edge effects to 2 acres of old growth and a loss of 2 acres of interior old growth for Alternatives 3E and 4E (see section 3.21, *Vegetation*) and are not shown.
[2] Old growth designated to mitigate impacts to old growth. See section 3.21, *Vegetation* for a more detailed description of old growth mitigation.
[3] PPI with mitigation based on assumption that old growth designated in association with mitigation provides replacement old growth.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 2 – MMC's Proposed Mine

As shown in Table 171, Alternative 2 would affect about 304 acres of effective old growth habitat and 3 acres of replacement old growth habitat in the Crazy PSU, reducing nesting and foraging habitat and habitat quality for the pileated woodpecker. No effective or replacement old growth would be directly affected by Alternative 2 in the Silverfish PSU or on private or state land east of the Silverfish PSU. Direct impacts to old growth resulting from Alternative 2 would be too small to change the existing PPI. Alternative 2 would result in edge effects to about 125 acres of old growth habitat and a loss of about 443 acres of interior, potentially reducing the capacity of remaining old growth stands to support the pileated woodpecker or some of the old growth-associated wildlife species it represents. The majority of impacts to potential pileated woodpecker habitat would occur in Little Cherry Creek Impoundment and LAD Area 2 at the mouth of Ramsey and Poorman creeks, reducing habitat connectivity between these drainages. Several old growth blocks would be reduced in size, diminishing their capacity to support pileated woodpeckers. The Alternative 2 tailings impoundment would result in the loss of 197 acres of old growth in one localized area, which could displace one or more nesting pairs that may have traditionally used the area. Old growth impacts associated with Alternative 2 could include the removal of a nest tree or night winter roost tree used by the pileated woodpecker or some of the old growth-associated wildlife species it represents. Impacts to old growth habitat are described in section 3.21.2, *Old Growth Ecosystems*. Loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and acquired parcels could be managed to benefit pileated woodpeckers. As described in section 3.24.2, *Key Habitats*, Alternative 2 would result in the loss of snags greater than 20 inches diameter at breast height (dbh) and down logs greater than 10 inches dbh that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain greater than KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Snag losses would not likely increase due to roads constructed for Alternative 2 because these roads would be closed to the public.

According to recommendations provided by McClelland (1979) and McClelland *et al.* (1979), riparian old growth habitat in the northern Rocky Mountains should be at least 300 feet in width to meet pileated woodpecker habitat requirements. Although MMC's proposed Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*) would be implemented, construction of the impoundment, roads, bridges, and other mine facilities associated with Alternative 2 would disturb about 37 acres of wetland and riparian habitat and could contribute to habitat fragmentation. Impacts to riparian habitat are described in section 3.21, *Vegetation*.

Noise and other human-caused disturbances, such as blasting, construction of the plant and adit sites, road construction and use, and plant and adit operations could cause pileated woodpeckers to avoid nearby habitat, at least temporarily. Disturbance impacts would likely be greatest during the construction phase, but could persist through mine operations.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Direct impacts of Alternative 3 on old growth habitat potentially supporting pileated woodpeckers would be similar to Alternative 2, except that Alternative 3 would affect less old growth. About 180 acres of effective habitat and 3 acres of replacement habitat in the Crazy PSU would be disturbed in Alternative 3 (Table 171). Direct impacts to old growth resulting from Alternative 3 would be too small to change the existing PPI. Alternative 3 would result in edge effects to about 167 acres of old growth habitat and a loss of about 356 acres of interior, potentially reducing the capacity of remaining old growth stands to support the pileated woodpecker or some of the old growth-associated wildlife species it represents. The majority of impacts to designated old growth would occur as a result of the Poorman Impoundment construction or in LAD Area 2 at the mouth of Ramsey and Poorman creeks, reducing habitat connectivity between these drainages. Several old growth blocks would be reduced in size, diminishing their capacity to support pileated woodpeckers. The Alternative 3 tailings impoundment would result in the loss of 154 acres of old growth in one localized area, which could displace one or more nesting pairs that may have traditionally used the area. Old growth impacts associated with Alternative 3 could include the removal of a nest tree or night winter roost tree used by the pileated woodpecker or some of the old growth-associated wildlife species it represents.

As described in section 3.21, *Vegetation*, the agencies' mitigation in Alternative 3 would include the designation of 587 acres of additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics, potentially improving the quality of habitat for pileated woodpeckers. Loss of old growth providing potential pileated woodpecker habitat also may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and acquired parcels could be managed to benefit pileated woodpeckers.

Construction of the impoundment, roads, bridges, and other mine facilities associated with Alternative 3 would result in the disturbance of about 14 acres of wetland and riparian habitat and could contribute to habitat fragmentation. Impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). As described in sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*, all wetlands affected would be replaced with wetlands with similar functions and values. Impacts to riparian habitat are described in section 3.21, *Vegetation*. Impacts from noise and human activities associated with Alternative 3 would be similar to Alternative 2.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts of Alternative 4 on old growth habitat potentially supporting pileated woodpeckers would be similar to Alternative 2, except that Alternative 4 would affect less old growth. Alternative 4 would affect about 172 acres of effective habitat, and 3 acres of replacement habitat in the Crazy

PSU (Table 171), edge effects to about 167 acres of old growth habitat, and a loss of about 356 acres of interior habitat.

Impacts of Alternative 4 on riparian habitat potentially supporting pileated woodpeckers would be the same as Alternative 3. Impacts from noise and human activities associated with Alternative 4 would be similar to Alternatives 2 and 3.

The Alternative 4 tailings impoundment would result in the loss of 151 acres of old growth in one localized area, which could displace one or more nesting pairs that may have traditionally used the area. Old growth impacts associated with Alternative 4 could include the removal of a nest tree or night winter roost tree used by the pileated woodpecker or some of the old growth-associated wildlife species it represents.

As described in section 3.21, *Vegetation*, Alternative 4 would include the designation of 659 acres additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics, potentially improving the quality of habitat for pileated woodpeckers. Also, loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and acquired parcels could be managed to benefit pileated woodpeckers.

Alternative A – No Transmission Line

There would be no impacts to pileated woodpecker (old growth habitat) from Alternative A, and no change in PPI (Table 172).

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

As shown in Table 172, Alternative B would affect about 23 acres of effective habitat in the Crazy PSU. No replacement old growth would be impacted in the Crazy PSU, and no old growth in the Silverfish PSU would be directly affected by Alternative B. Physical removal of old growth resulting from Alternative B would be too small to change the existing PPI. Alternative B would result in edge effects to about 102 acres of old growth habitat and a loss of about 127 acres of interior old growth habitat, potentially reducing the capacity of remaining old growth stands to support the pileated woodpecker or some of the old growth-associated wildlife species it represents. Alternative B would remove about 4 acres of old growth habitat on private land along the Fisher River and a short portion of Miller Creek. The majority of impacts to old growth would occur in the Ramsey Creek corridor and at the confluence of Libby and Howard creeks, reducing habitat connectivity in these drainages. Reducing the size of old growth blocks would diminish their capacity to support pileated woodpeckers. Loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and they could be managed to benefit pileated woodpeckers.

As described in section 3.24.2, *Key Habitats*, Alternative B would result in the loss of snags greater than 20 inches dbh and down logs greater than 10 inches dbh that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain greater than KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Snag losses would not likely

increase due to roads constructed for Alternative B because these roads would be closed to the public.

According to recommendations provided by McClelland (1979) and McClelland *et al.* (1979), riparian old growth habitat in the northern Rocky Mountains should be at least 300 feet in width to meet pileated woodpecker habitat requirements. Although the clearing area for Alternative B would include about 13 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of MMC's proposed Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*), and the Environmental Specifications (Appendix D). Impacts to riparian habitat are described in section 3.21, *Vegetation*.

Noise from helicopters during line stringing could cause pileated woodpeckers to avoid nearby habitat, at least temporarily. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning. Helicopter use and other activities would cause similar disturbances with similar durations during line decommissioning.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would have similar physical impacts to pileated woodpecker habitat as Alternative B, except that less effective old growth would be disturbed in the Crazy PSU. As shown in Table 172, Alternative C would affect about 8 acres of effective habitat in the Crazy PSU. Physical removal of old growth resulting from Alternative C would be too small to change the existing PPI. Alternative C would result in edge effects to about 23 acres of old growth habitat and a loss of about 51 acres of interior on KNF lands, reducing the capacity of remaining old growth stands to support pileated woodpeckers. Reducing the size of old growth blocks would diminish their capacity to support pileated woodpeckers. The majority of impacts to old growth would occur at the confluence of Libby and Howard creeks, reducing habitat connectivity between these drainages. Alternative C would remove about 2 acres of old growth habitat on private land where the transmission line crossed the Fisher River.

As described in section 3.21, *Vegetation*, Alternative C would include the designation of 39 acres of additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics, potentially improving the quality of habitat for pileated woodpeckers. Impacts to old growth on non-National Forest System lands would be minimized through implementation of the Environmental Specifications (Appendix D) and Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*). Loss of old growth providing potential pileated woodpecker habitat may also be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

Impacts to snag habitat from Alternative C would be the same as Alternative B.

Although the clearing area for Alternative C would include about 5 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix

D). Impacts to riparian habitat are described in section 3.21, *Vegetation*. Noise and other human-caused disturbance to pileated woodpeckers would be the same for Alternative C as Alternative B, except that helicopter disturbance during construction could last up to 2 months longer where helicopters were used for clearing and line construction, and other construction activities in areas where helicopters were not used would be less extensive than for Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Impacts of Alternative D on old growth habitat potentially supporting pileated woodpeckers would be similar to Alternative C, except that Alternative D would result in slightly more direct impacts and edge effects to old growth. As shown in Table 172, Alternative D would affect about 13 acres of effective habitat in the Crazy PSU, edge effects to about 38 acres of old growth habitat, and a loss of about 52 acres of interior habitat. Mitigation measures would be the same for Alternative D as Alternative C, except that Alternative D would include the designation of 64 acres of additional old growth on National Forest System lands. Impacts to snag habitat from Alternative D would be the same as Alternative B.

Although the clearing area for Alternative D would include about 14 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). Impacts to riparian habitat are described in section 3.21, *Vegetation*. Noise and other human-caused disturbance to pileated woodpeckers would be the same for Alternative D as Alternative B.

Alternative E – West Fisher Creek Transmission Line Alternative

Direct impacts to pileated woodpecker habitat from Alternative E would be the same as Alternative D, except that less wetland and riparian habitat would be affected. Although the clearing area for Alternative E would include about 11 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). Impacts to riparian habitat are described in section 3.21.1.3.3, *Wetlands and Riparian Areas*.

Alternative E would directly impact about 6 acres of old growth habitat on private and state land where the transmission line crossed the Fisher River and parallel West Fisher Creek. Mitigation of impacts to old growth on private and state land would be the same as Alternative D. Noise and other human-caused disturbance to pileated woodpeckers would be the same for Alternative E as Alternative B.

Combined Mine-Transmission Line Effects

Impacts to pileated woodpecker in the Crazy PSU from the combined mine-transmission line alternatives are summarized in Table 173. Impacts of the combined mine and transmission line alternatives on potential pileated woodpecker habitat (old growth) in the Silverfish PSU would be limited to edge effects to 2 acres of old growth and a loss of 2 acres of interior old growth for Alternatives 3E and 4E and are not shown in Table 173.

Table 173. Effects on Potential Pileated Woodpecker Habitat and Population Index by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Unmitigated Effects								
Effective OG (acres)	7,206	6,884 (-322)	7,018 (-188)	7,013 (-193)	7,013 (-193)	7,026 (-180)	7,021 (-185)	7,021 (-185)
Replacement OG (acres)	239	236 (-3)	236 (-3)	236 (-3)	236 (-3)	236 (-3)	236 (-3)	236 (-3)
PPI	12	12	12	12	12	12	12	12
Mitigated Effects								
Total old growth designated (acres) [1]	N/A	0	626	651	651	698	723	723
PPI with mitigation[2]	N/A	12	13	13	13	13	13	13
KNF								
Unmitigated Effects								
Effective OG (acres)	199,109	198,787 (-322)	198,921 (-188)	198,916 (-193)	198,916 (-193)	198,929 (-180)	198,924 (-185)	198,924 -(185)
Replacement OG (acres)	98,064	98,061 (-3)	98,061 (-3)	98,061 (-3)	98,061 (-3)	98,061 (-3)	98,061 (-3)	98,061 (-3)
PPI	430	429	430	430	430	430	430	430
Mitigated Effects								
PPI with mitigation[2]	N/A	429	431	431	431	431	431	431
Private Land								
Old growth removed (acres)	N/A	4	2	2	2	2	2	2

OG = old growth.
Number in parentheses is the reduction in habitat acres due to the alternative compared to Alternative 1, No Mine/Existing Condition.
Impacts of the combined mine-transmission line alternatives on potential pileated woodpecker habitat (old growth) in the Silverfish PSU would be limited to edge effects to 2 acres of old growth and a loss of 2 acres of interior old growth for Alternatives 3E and 4E (see section 3.21, *Vegetation*) and are not shown.
[1] Old growth designated to mitigated impacts to old growth. See section 3.21, *Vegetation* for a more detailed description of old growth mitigation.
[2] PPI with mitigation based on assumption that old growth designated in association with mitigation provides replacement old growth.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Impacts to old growth providing potential pileated woodpecker habitat from combined mine-transmission line alternatives would be the greatest for MMC's proposed alternative (Alternative 2B). Alternative 2B would directly impact 225 acres of old growth, increase edge by 227 acres, and decrease interior habitat by 570 acres. Direct impacts to old growth from the combined agencies' alternatives (Alternatives 3C, 3D, 3E, 4C, 4D, and 4E), including impacts on private and state land, would range from 185 acres to 202 acres. Combined agencies' alternatives would increase edge by between 150 acres for Alternative 4C and 205 acres for Alternatives 3D and 3E. For all combined action alternatives, the tailings impoundment would result in the loss of 151 to 197 acres of old growth in one localized area, which could displace one or more nesting pairs that may have traditionally used the area. Old growth impacts associated with all combined action alternatives could include the removal of a nest tree or night winter roost tree used by the pileated woodpecker or some of the old growth-associated wildlife species it represents. Impacts to old growth from the combined mine-transmission line alternatives are described in section 3.21.2, *Old Growth Ecosystems*. Loss of old growth providing potential pileated woodpecker habitat may be offset.

The combined action alternatives would affect between 2 and 6 acres of old growth on private and state land. Impacts to old growth on private land would be minimized through implementation of the Environmental Specifications and, for the combined agencies' alternatives, the Vegetation Removal and Disposition Plan described in section 2.5.3.2.1, *Vegetation Removal and Disposition*.

As described in section 3.24.2, *Key Habitats*, all combined action alternatives would result in the loss of snags greater than 20 inches dbh and down logs greater than 10 inches dbh that provide potential nesting and foraging habitat for pileated woodpeckers. In all combined mine-transmission line alternatives, snag densities and quantities of down wood would remain greater than KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Snag losses would not likely increase due to roads constructed for the combined action alternatives because these roads would be closed to the public.

Although all combined action alternatives would affect wetland and riparian areas, impacts would be minimized through implementation of MMC's proposed Wetland Mitigation Plan, the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (see sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). As described in sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*, all wetlands affected would be replaced with wetlands with similar functions and values. Impacts to riparian habitat are described in section 3.21.1.3.3, *Wetlands and Riparian Areas*.

In all combined action alternatives, noise from helicopters during line stringing and from other construction-related activities may cause pileated woodpeckers to avoid nearby habitat, at least temporarily. Disturbance impacts from blasting and helicopters would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C above. Disturbance impacts during mine operations would probably be lower in intensity, but would last through the life of the mine.

As described in section 3.21, *Vegetation*, the agencies' alternatives would include the designation of between 626 and 723 acres of additional old growth on National Forest System lands (see section 3.21, *Vegetation*), potentially improving habitat for an additional breeding pair of pileated woodpeckers. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics, potentially improving habitat quality for pileated woodpeckers. For all combined action alternatives, impacts to old growth on private land would be minimized through implementation of the Environmental Specifications (Appendix D) and Vegetation Removal and Disposition Plan described in section 2.5.3.2.1, *Vegetation Removal and Disposition*. In all combined action alternatives, losses and degradation of providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and they could be managed to benefit pileated woodpeckers.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; and increases in tree density and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provided access to old growth habitat, contributing removal of snags important to pileated woodpeckers. Continuing development of private lands, including timber harvest, home construction, and land clearing, would contribute to losses of pileated woodpecker habitat in the analysis area. Impacts to pileated woodpecker on private and state lands would probably be minimal because it is likely that limited amounts of old growth occur on private and state lands, based on past and current harvest practices.

Regeneration harvest included in the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, would not directly affect old growth providing potential pileated woodpecker habitat. The Miller-West Fisher Vegetation Management Project would result in minor increased edge effects where regeneration harvest is proposed adjacent to old growth. While the combined action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of pileated woodpecker habitat, cumulative impacts on overall amounts of old growth would likely be minimal. In addition, mitigation associated with combined agencies' alternatives would increase the proportion of designated old growth and promote the maintenance or development of pileated woodpecker habitat in the analysis area.

Cumulative noise and other human-caused disturbances could occur as a result of the combined action alternatives and other reasonably foreseeable actions. Cumulative disturbance effects could affect individual pileated woodpeckers, but would not likely affect pileated woodpecker populations in the KNF.

3.24.3.5.4 Regulatory/Forest Plan Consistency

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13) (see 3.14.2.2, *Methods*). The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would

be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

Analysis of old growth forest-wide (USDA Forest Service 2007d) concludes that at least 10 percent of the KNF below 5,500 feet is managed as old growth, as required in the KFP. Specifically, National Forest System lands below 5,500 feet include 297,173 acres (15.9 percent) of old growth or replacement old growth. About 10.7 percent (199,109 acres) of those lands were determined to be effective old growth, and 5.2 percent (98,064 acres) were identified as replacement old growth.

The action alternatives would result in between 16.4 and 18.2 percent designated old growth below 5,500 feet elevation in the Crazy PSU, and 12.9 percent designated old growth below 5,500 feet elevation in the Silverfish PSU. The KFP established that maintaining 10 percent of old growth habitat is sufficient to support viable populations of old-growth dependent species (KFP Vol. 1, II-1 #7 and III-54; Vol. 2, A-17).

All action alternatives would be consistent with KFP direction for snags and down wood (see section 3.24.2, *Key Habitats*). In all combined mine-transmission line alternatives, a wide range of successional habitats and associated amounts of down wood would be available. The action alternatives would be consistent with KFP direction to maintain diverse age classes of vegetation for viable populations (KFP II-1 #7).

Summary Old Growth, Snag and Down Wood Habitat MIS Statement. Based on the analysis for pileated woodpecker and the KNF Conservation Plan (Johnson 2004a), in all action alternatives, habitat for old growth forest species and cavity habitat users would be provided in sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all action alternatives, sufficient old growth forest, and snag and down wood habitat would be available; the populations of species using that habitat should remain viable.

3.24.3.6 Irreversible and Irretrievable Commitments

There would be no irreversible commitments of MIS habitat due to any of the action alternatives.

Irretrievable commitments of elk, white-tailed deer, mountain goat, and pileated woodpecker habitat would occur in the Crazy and Silverfish PSUs due to decreases in cover, increases in road densities, decreases in habitat security, decreases in habitat effectiveness, habitat losses, and increases in disturbance associated with the action alternatives. For the action alternatives, recovery of habitat security and habitat effectiveness, and reduction of ORD to pre-mine conditions would not occur until after mine closure and reclamation. For the transmission line alternatives, recovery of deer and elk habitat would be quicker, and would begin after transmission line construction.

3.24.3.7 Short-term Uses and Long-term Productivity

Most losses of cover, increases in road densities, decreases in habitat security, decreases in habitat effectiveness, and increases in disturbance associated with the mine alternatives would last until mine closure and reclamation. Most human-caused disturbance effects on mountain goat habitat would occur only during blasting; some disturbance effects from mine operations would last until mine closure. For the transmission line alternatives, increases in road densities, decreases in habitat security, decreases in habitat effectiveness, and human-caused disturbance of deer, elk,

mountain goats, and pileated woodpecker would be short-term, and would last until the transmission line was built.

3.24.3.8 Unavoidable Adverse Environmental Effects

Unavoidable adverse effects would occur from all action alternatives in the Crazy and Silverfish PSUs where new roads were constructed, gated or barriered roads were opened, mine and transmission line facilities were built, and mine operations occurred.

3.24.4 Forest-Sensitive Species

3.24.4.1 Regulatory Framework

Section 3.6, *Aquatic Life and Fisheries* discusses the regulatory framework for forest-sensitive species. Sensitive wildlife species on the KNF are listed in Table 174. State wildlife Species of Concern are discussed in section 3.24.7, *Other Species of Interest*. Bald eagles are also protected by two federal laws: the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The Eagle Act, originally passed in 1940, prohibits the "take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export, or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit" (16 U.S.C. 668(a); 50 CFR 22). "Take" is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." The term "disturb" under the Eagle Act is defined as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (72 Fed. Reg. 31332).

3.24.4.2 Bald Eagle

3.24.4.2.1 Analysis Area and Methods

Eagle population ecology, biology, habitat description, and relationships identified by research are described in Montana Bald Eagle Working Group (MBEWG) (1991, 1994); USFWS (1995, 1999); and USFWS (2007a). That information is incorporated by reference. Eagle occurrence data come from recent District wildlife observation records, Forest historical data (NRIS FAUNA), KNF monitoring data (USDA Forest Service 2005c), and other agencies (USFWS, FWP).

The National Bald Eagle Management Guidelines (NBEMG) (USFWS 2007b) provide recommendations for avoiding disturbance to bald eagles, and also encourages the continued development and use of state-specific management plans. The Montana Bald Eagle Management Plan (MBEMP) (MBEWG 1991, 1994) states that the Plan "will also serve as the conservation and management plan when bald eagles are delisted." The guidelines provided in the MBEMP meet the recommendations from the NBEMP; therefore, effects of project alternatives on potential eagle habitat and any known eagle nests are evaluated based on whether or not they meet guidelines from the MBEMP.

Table 174. Sensitive Wildlife Species on the KNF.

Sensitive Species	Status In Analysis Area*	Comments**
Bald Eagle (*Haliaeetus leucocephalus*)	K	
Black Backed Woodpecker (*Picoides arcticus*)	S	2
Coeur d'Alene Salamander (*Plethodon vandykei idahoensis*)	S	
Common Loon (*Gavia immer*)	K	4
Fisher (*Martes pinnanti*)	K	
Flammulated Owl (*Otus flammeolus*)	K	
Harlequin Duck (*Histrionicus histrionicus*)	NS	2
Northern Bog Lemming (*Synaptomys borealis*)	NS	1, 2, 3
Northern Leopard Frog (*Rana pipiens*)	NS	2
Peregrine Falcon (*Falco peregrinus*)	NS	2, 4
Townsend's Big-eared Bat *(Corynorhinus townsendii)*	K	
Western Toad (*Bufo boreas*)	K	
Wolverine (*Gulo gulo*)	K	

*Status Key:
K = Species is known to occur within the analysis area.
S = Species is suspected to occur within analysis area.
NS = Species is not suspected to occur within the analysis area, and is dropped from further evaluation.
**Comment Key:
1 = Suitable habitat does not occur in the analysis area.
2 = No records in the analysis area vicinity.
3 = Analysis area is not within the known range of the species.
4 = May occur in the analysis area, but known suitable habitat would not be affected by the proposed project. Species is dropped from further analysis.
Source: Kimbell 2004, 2005; Westech 2005a; and KNF data for District observation and historical records (NRIS FAUNA).

MBEMP guidelines identify four general habitat categories and management concerns for bald eagles: nesting habitat, foraging habitat (including perch sites), winter habitat (including roost sites), and mortality risks.

Nesting habitat is typically associated with mature forest stands in close proximity (less than 1 mile) to large bodies of water, including lakes and streams, which provide an adequate prey base.

Nesting habitat includes three management zones: 1 – nest site area, 2 – primary use area, and 3 – home range. A description of each zone and associated management objectives and guidelines are found in the MBEMP (MBEWG 1994) and are included by reference. Management zones are defined as:

- Zone 1 is within 0.25 mile radius of a nest site
- Zone 2 is from 0.25 to 0.5 mile radius of nest site
- Zone 3 is suitable foraging habitat within 2.5 miles of nest site

Foraging habitat consists of lakes, rivers, wetlands, and meadows, which provide open flight paths, perches, and adequate prey. Foraging habitat also includes highway and railroad corridors (especially in the winter) where animals killed by vehicles or trains occur. Winter habitat is generally dictated by the presence and abundance of food, open water, and secure night roost sites (MBEWG 1994). Potential causes of bald eagle mortality are identified in the MBEMP (MBEWG 1994) and include shooting, accidental trapping, poisoning, diseases, and electrocution. Potential risks of vehicle collision while feeding on roadkill will also be estimated.

Guidelines for avoiding disturbance to bald eagles specified in the MBEMP (MBEWG 1991, 1994) include:

- No additional human activity, including low-intensity activity, within the nest site area during the breeding season (February 1 to August 15).
- No high intensity activities or construction of permanent developments within primary use area during the breeding season.
- No overhead utility lines or other hazards constructed within primary use area.
- Minimization of disturbance, habitat alteration, and hazards within home range.
- No human activity within 0.25 mile of high use winter perches or winter concentration areas from sunset until mid-morning. Human activity distance may be adjusted according to site-specific conditions.
- No human activity within 0.25 mile of critical and vital roosts during fall, winter, and spring use periods, as defined by the MBEMP (MBEWG 1994).

The analysis area for project impacts and cumulative effects to individuals and their habitat is all lands within the Crazy and Silverfish PSUs within the bald eagle habitat area boundaries agreed to by the USFWS (USFWS 2001); alternative disturbance within 0.5 mile of a nest site; and alternative disturbance in wetland or aquatic habitat within 2.5 miles of a nest site. This area includes the Sedlak Park Substation and loop line.

The impacts analysis includes an evaluation of the potential benefits to bald eagles from mitigation measures proposed by MMC or the agencies described in sections 2.5.7.3, *Wildlife Mitigation* and 2.9.4, *Wildlife Mitigation Measures* and Appendix D, such as recommendations outlined in Suggested Practices for Avian Protection on Power Lines (APLIC 2006) and Mitigating Bird Collisions with Power Lines (APLIC 1994).

3.24.4.2.2 Affected Environment

The bald eagle was removed from the federal threatened species list on August 8, 2007. It was then placed on the Forest Service Northern Region's sensitive species list for a period of 5 years.

The status of the bald eagle will then be reviewed to determine whether or not to retain it as a sensitive species.

Bald eagles occur as both seasonal migrants and year-round residents within the boundaries of the KNF. Based on the bald eagle habitat area boundaries agreed to by the USFWS (USFWS 2001), about 564,558 acres (242,965 acres National Forest System land, 275,470 acres private land, and 46,123 acres open water) of potential bald eagle habitat occurs in the KNF (USFWS 2001). Nesting on the KNF has increased significantly over the last 2 decades. Only one active nest was known to occur in 1978, whereas 44 pair territories (19 on National Forest System lands and 25 on private land), including 15 active nest sites on National Forest System land, were known and monitored in 2007. Nest success for active nests over the last 20-year period is about 83 percent, with an average of 1.3 fledglings per active nest (KNF bald eagle monitoring records). In early 2006, a pair of bald eagles initiated nesting at a site, known as the Silverfish nest, located along the Fisher River just north of Silver Butte Road and just west of U.S. 2 in the Silverfish PSU, about 600 feet west of MMC's proposed transmission line alignment (Figure 89). Although breeding at this nest site was not successful in 2006, two young eagles were successfully fledged from this nest in 2007. Another active nest site is located along the Fisher River on private land about 1.4 miles north of the proposed transmission line (Figure 89). Bald eagles tend to use the same breeding area, and often the same nest, each year (MBEWG 1994) and these nests are likely to be active in the future. There are no bald eagle nest sites in or near the Crazy PSU.

Several bald eagle foraging, perching, and roosting areas are located along the Fisher River in or near the Silverfish PSU. Bald eagle foraging is occasionally observed along U.S. 2 and in the major drainages in the Silverfish PSU (Bratkovich, pers. comm. 2006). In the fall, eagle use of Libby Creek is usually limited to about 8 miles upstream of its confluence with the Kootenai River.

Wintering bald eagle numbers have fluctuated depending on food sources (fish from open waters and dead animals along roads and railroad tracks) and winter conditions (open versus frozen water for foraging habitat). Mid-winter bald eagle counts throughout the KNF have averaged 96 bald eagles over the past 20 years (USDA Forest Service 2006d). Any winter use by bald eagles in the analysis area is generally limited to the U.S. 2 corridor along the eastern edge of the Silverfish PSU.

In the Silverfish PSU, there is a small risk of eagle collisions with motor vehicles traveling along U.S. 2. Because there are no highways in the Crazy PSU, the risk of mortality from vehicle collisions is low. The risk of mortality from other sources is generally low in both PSUs.

3.24.4.2.3 Environmental Consequences

This section describes the potential impacts to bald eagles from the transmission line alternatives. Impacts on bald eagle habitat are shown in Table 175 and described in the subsections below. Because the mine alternatives would not affect bald eagles, impacts from the mine alternatives and combined mine-transmission line alternatives are not discussed.

Table 175. Transmission Line Impacts on Bald Eagle Nesting Habitat and Potential Bald Eagle Habitat by Alternative.

Transmission Line Alternative	Nearest Distance to Nest Site (miles)	Nest Site Area (Zone 1)[1] (acres)	Primary Use Area (Zone 2)[2] (acres)	Home Range Foraging Area (Zone 3)[3] (acres)	Other Potential Bald Eagle Habitat[4] (acres)
A-No Action	0	0	0	0	0
B-North Miller Creek	0.10	8	9	28	103
C-Modified North Miller Creek	0.67	0	0	18	131
D-Miller Creek	0.67	0	0	18	131
E-West Fisher Creek	0.67	0	0	30	107

Transmission line disturbance area includes typical tree clearing width of 150 feet for Alternative B and 200 feet for Alternatives C, D, and E.
Areas of impact overlap between zones are not counted.
[1] Zone 1 = within 0.25 mile radius of nest site.
[2] Zone 2 = from 0.25 to 0.5 mile radius of nest site.
[3] Zone 3 = suitable foraging habitat within 2.5 miles of nest site. Foraging habitat consists of rivers, streams, and wetland areas.
[4] Other potential bald eagle habitat = all lands within the bald eagle habitat area boundaries agreed to by the USFWS (USFWS 2001).
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative A – No Transmission Line

Alternative A would not impact bald eagle nesting, foraging, wintering, or other potential habitat and would not add to bald eagle mortality risk.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

About 4 miles of MMC's Proposed Transmission Line would have direct impacts on about 8 acres of bald eagle habitat in the nesting zone (Table 175). About 28 acres of home range foraging area for nesting bald eagles, and about 103 acres of other potential bald eagle habitat would be affected. As described in section 3.21, *Vegetation*, the clearing area for Alternative B would include about 4 acres of old growth habitat on private land along the Fisher River and a short stretch of Miller Creek. Alternative B would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. The clearing area associated with Alternative B would be within the 660-foot buffer recommended in the NBEMG (USFWS 2007b). Bald eagles often avoid areas of high human use for nesting, foraging, perching, and roosting; they have shown a wide range of sensitivity to human disturbance (Stalmaster and Newman 1978; Knight and Knight 1984; Martell 1992; Beuhler *et al.* 1991; McCarigal *et al.* 1991). In addition to physical losses of habitat, impacts on bald eagles from Alternative B may include disturbance of breeding bald eagles and nest abandonment due to increased noise and the presence of humans and machinery. Temporary disturbance impacts from

Alternative B may also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. Disturbance impacts to bald eagles would be avoided through implementation of timing restrictions specified in the Environmental Specifications (Appendix D).

The likelihood of the 230-kV transmission line resulting in the electrocution of bald eagles or other raptors is extremely low; electrocution of raptors is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Also, electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and compliance with Environmental Specifications (Appendix D), including restrictions on the location of overhead utility lines. The transmission line from BPA's loop line would not pose a risk of electrocution of raptors because phase spacing would be a minimum of 20 feet.

Although raptors are generally less vulnerable to collisions with power lines than other bird species (Olendorff and Lehman 1986), the proximity of the Alternative B transmission line, including BPA's Substation and loop line, to nesting bald eagles and their foraging habitat along the Fisher River would add to the risk of bald eagle collisions with the transmission line. Potential collisions of bald eagles with the transmission line would be reduced by constructing the transmission line according to recommendations outlined in APLIC (1994) and compliance with the Environmental Specifications (Appendix D), including restrictions on the location of overhead utility lines. Applicable recommendations include locating the transmission line away from streams, mountain passes, and other potential flight corridors, placement of the lines below treeline or other topographical features, and installation of line marking devices. The latter recommendation would be particularly relevant where the transmission line paralleled and crossed the Fisher River. As discussed in section 2.9.4, *Wildlife Mitigation Measures*, areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would have no direct physical impacts on bald eagle habitat in the nesting zone. About 18 acres of bald eagle foraging habitat and 131 acres of other potential habitat would be temporarily disturbed during construction of Alternative C (Table 175). As described in section 3.21, *Vegetation*, the clearing area for Alternative C would include about 2 acres of old growth habitat on private land along the Fisher River. Alternative C would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. Temporary disturbance impacts from Alternative C could also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. These impacts are likely to be minor, given the availability of foraging habitat in the surrounding area.

The location of the Alternative C transmission line alignment on an east-facing ridge immediately north of the Sedlak Park Substation would reduce the risks of bald eagle wire strikes and electrocutions relative to Alternative B. Similar to Alternative B, recommendations outlined in Suggested Practices for Avian Protection on Power Lines (APLIC 2006) and Mitigating Bird

Collisions with Power Lines (APLIC 1994), as well as the Environmental Specifications (Appendix D) would be implemented.

Alternative D – Miller Creek Transmission Line Alternative

The impacts to bald eagles from Alternative D would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Alternative E would have no direct physical impacts on bald eagle habitat in the nesting zone. About 30 acres of bald eagle foraging habitat and 107 acres of other potential habitat would be temporarily disturbed during construction of Alternative E (Table 175). As described in section 3.21, *Vegetation*, the clearing area for Alternative E would include about 6 acres of old growth habitat on private and state land where the transmission line crossed the Fisher River and paralleled West Fisher Creek. Alternative E would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. Temporary disturbance impacts from Alternative E could also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. These impacts would likely be minor, given the availability of foraging habitat in the surrounding area. Also, disturbance impacts to bald eagles would be avoided through implementation of timing restrictions specified in the Environmental Specifications. The risks of bald eagle wire strikes and electrocutions would be the same as Alternatives C and D.

Cumulative Effects

Alternative A would not contribute to any cumulative effects on the bald eagle or its habitat. No other past, current, or reasonably foreseeable actions are anticipated to contribute to cumulative impacts on bald eagles, with the possible exception of private land development activities. Impacts to bald eagle from the transmission line alternatives would mostly be avoided through implementation of timing restrictions and other measures specified in APLIC (1994), APLIC (2006), and the Environmental Specifications (Appendix D).

3.24.4.2.4 Regulatory/Forest Plan Consistency

Eagle Act

The transmission line alternatives would likely result in minimal impacts to the bald eagle, and would be in compliance with the Eagle Act (16 U.S.C. 668-668C 1978).

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6). The MBEWG guidelines state that “structures that pose a hazard such as overhead utility lines should not be constructed within Zone II (Primary Use Area) of all nests.” Alternative B would not be consistent with KFP guidelines because it would be constructed within the Primary Use Area for the Silverfish nest site. All other alternatives would meet KFP direction for the bald eagle.

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KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). The diversity requirement of NFMA is met for the bald eagle by all alternatives. Alternative B could impact individual bald eagles and their habitat, but would not likely contribute to a trend toward federal listing or loss of species viability. Transmission line Alternatives C, D, and E could impact potential bald eagle nesting and foraging habitat and would have minor impacts on individual bald eagles and their habitat, but would not likely contribute to a trend toward federal listing or loss of species viability.

3.24.4.3 Black-backed Woodpecker

3.24.4.3.1 Analysis Area and Methods

Black-backed woodpecker population ecology, biology, habitat description and relationships identified by research are described in Powell (2000), Cherry (1997), Hutto (1995), and O'Connor and Hillis (2001). That information is incorporated by reference. Black-backed woodpecker occurrence data come from recent District wildlife observation records and KNF historical data (NRIS FAUNA).

Effects of the alternatives on black-backed woodpecker were evaluated based on impacts to high-quality and general forest habitat, and changes in the number of breeding black-backed woodpecker pairs potentially supported in the analysis area (potential population level or PPL). Potential black-backed woodpecker habitat was estimated based on the KNF Cumulative Effects Model (CEM) vegetation data and the KNF CEM black-backed woodpecker habitat model (see KNF project record). The number of potential black-backed woodpecker breeding pair territories, referred to as the potential population index (PPI), was estimated based on documented home range sizes (Cherry 1997). The maximum home range size of 800 acres was applied to general forest habitat, while the minimum home range size of 175 acres was applied to high-quality habitat. The difference in territory size for the two habitat components is based on the assumption that higher quality habitat can support a breeding pair with fewer acres. High quality habitat is defined as areas where recent (less than 10 years old) mixed-lethal or stand-replacement fire have occurred or where an abundance of snags are available. Low quality habitat consists mainly of general forest habitat with small scattered patches of snags produced by insect and disease. Black-backed woodpeckers have been found to be almost entirely restricted to early post-fire forests (Hutto 1995).

The analysis area for project impacts and cumulative effects to individuals and their habitat in the KNF consists of the Crazy and Silverfish PSUs. To evaluate potential direct and indirect impacts of the transmission line on black-backed woodpeckers, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the transmission line alternatives. The analysis area for cumulative effects is the KNF and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The analysis area includes private and state lands crossed by the eastern portions of the transmission line alternatives. Specific black-backed woodpecker habitat information is not available for private or state-owned lands in the analysis area, much of which has been logged in the past 20 to 30 years. Black-backed woodpecker habitat on private and state land was estimated based on mapping of coniferous forest shown on Figure 83 and old growth forest shown on

Figure 84. Habitat quality on private and state land was evaluated based on past and current land use practices.

The impacts analysis includes an evaluation of the potential benefits to black-backed woodpecker from mitigation measures proposed by MMC or the agencies, such as black-backed woodpecker surveys and, if appropriate, the establishment of avoidance areas where tree removal would not occur.

3.24.4.3.2 Affected Environment

Habitat for black-backed woodpeckers consists of boreal and montane forest where wood-boring beetle (including *Monochamus* spp. and Englemann spruce beetle, *Dendroctonus englemanni*) outbreaks are occurring as a result of disturbances caused by fire, wind, and disease. Black-backed woodpecker habitat in the Crazy and Silverfish PSUs is mainly lower quality black-backed woodpecker habitat. This lower quality habitat supports low populations of resident black-backed woodpeckers. About 6,083 acres of general forest habitat occurs in the Crazy PSU, while 7,479 acres of general forest occurs in the Silverfish PSU. High quality habitat consists of 9,060 acres in the Crazy PSU and 7,958 acres in the Silverfish PSU. The estimated PPI for the Crazy and Silverfish PSUs is 59 pairs and 55 pairs, respectively.

As primary cavity-nesters, black-backed woodpeckers require dead or live trees with heartwood rot and show a preference for Douglas fir, ponderosa pine, lodgepole pine, and western larch. According to Thomas (1979, p. 74), a PPL of 40 percent or more should maintain viable populations of birds dependent on cavities for nest sites. The existing PPL for the Crazy and Silverfish PSUs is 69 and 73 percent, respectively.

On a forest-wide level, potential black-backed woodpecker habitat is abundant, broadly distributed, and amounts to 1,317,790 acres of general forest habitat. The nearest recorded observation of a black-backed woodpecker to the analysis area occurred in 1995 in a burned area west of Rock Creek (MNHP 2005). No recent burns were observed in the analysis area during field work conducted in 2005, although potential habitat for the black backed woodpecker occurs in old growth stands and in areas with western larch snags along the transmission line alignments (Westech 2005a). No black-backed woodpeckers were observed during black-backed woodpecker surveys of more than 1 mile of the Libby Creek wildfire burn area in 2003 and 2004 (see KNF project record). No black-backed woodpeckers were observed during breeding bird monitoring and point count surveys of old growth stands in and adjacent to the proposed impoundment sites and Libby Plant Site conducted in 1992 (Mitchell and Bratkovich 1993), 2002, and 2004 (see KNF project record). Similarly, no black-backed woodpeckers have been observed during Region One (USFS) landbird monitoring surveys of transects established directly northwest of the proposed LAD Area 1 and in Miller Creek along NFS road #4724 in 1994, 1995, 1996, 1998, 2000, 2002, and 2004 (ibid.). The majority of the non-National Forest System lands in the analysis area have high road densities, allowing access for firewood collection, and have been logged in the past 20 to 30 years (Figure 83), and it is not likely that snags have been left standing. As a result, snag and down wood important to black-backed woodpeckers is likely to be less available on private and state lands.

3.24.4.3.3 Environmental Consequences

Impacts to black-backed woodpecker from mine (Table 176) and transmission line alternatives (Table 177) are described in the following subsections. The mine alternatives would not affect black-backed woodpeckers in the Silverfish PSU and are not displayed in Table 176.

Alternative 1 – No Mine

Impacts to black-backed woodpecker habitat resulting from the mine alternatives are shown in Table 176. The No Mine Alternative would not have any direct impacts to black-backed woodpeckers or their habitat.

Alternative 2 – MMC's Proposed Mine

Alternative 2 would have no effect on black-backed woodpecker habitat in the Silverfish PSU. In the Crazy PSU, about 416 acres of general forest habitat and 473 acres of high-quality black-backed woodpecker habitat would be impacted by Alternative 2, reducing the PPI by 3 pairs to 56 nesting pairs (Table 176). Although individual black-backed woodpeckers may be affected, effects on the black-backed woodpecker population would be minimal, given the quantity of existing habitat. Despite several surveys conducted in the Crazy and Silverfish PSUs, no black-backed woodpecker nests were identified in the analysis area. Because potential black-backed woodpecker habitat occurs in the analysis area, Alternative 2 could result in the destruction of black-backed woodpecker nests or nest abandonment by black-backed woodpeckers. The Alternative 2 tailings impoundment would result in the loss of 715 acres of potential habitat in one localized area, which could displace one or more nesting black-backed woodpecker pairs that may have traditionally used the area.

Table 176. Impacts to Black-backed Woodpecker Habitat in the Crazy PSU and the KNF by Mine Alternative.

Habitat Type	[1] No Mine/Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment	[4] Agency Mitigated Little Cherry Creek Impoundment
Crazy PSU				
General Forest Foraging Habitat (acres)	6,083	5,667 (-416/-7)	5,541 (-542/9)	5,760 (-323/-5)
High Quality Habitat (acres)	9,060	8,587 (-473/-6)	8,799 (-261/-3)	8,433 (-627/-7)
PPI[1]	59	56	57	55
KNF				
PPI	1,647	1,644	1,645	1,643

Number in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.

[1] Based on a home range size of 800 acres for general forest habitat and 175 acres for high-quality habitat.

Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 177. Impacts to Black-backed Woodpecker Habitat in the Analysis Area by Transmission Line Alternative.

Habitat Type	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line	[D] Miller Creek Transmission Line	[E] West Fisher Creek Transmission Line
Crazy PSU					
General Forest Foraging Habitat (acres)	6,083	6,062 (-21/<-1)	6,062 (-21/<-1)	6,058 (-25/<-1)	6,058 (-25/<-1)
High Quality Habitat (acres)	9,060	9,048 (-12/<-1)	9,051 (-9/<-1)	9,047 (-13/<-1)	9,047 (-13/<-1)
PPI[1]	59	59	59	59	59
Silverfish PSU					
General Forest Foraging Habitat (acres)	7,479	7,465 (-14/<-1)	7,465 (-14/<-1)	7,471(-8/<-1)	7,471 (-8/<-1)
High Quality Habitat (acres)	7,958	7,942 (-16/<-1)	7,941(-17/<-1)	7,926 (-32/<-1)	7,896 (-62/<-1)
PPI[1]	55	55	55	55	54
KNF					
PPI	1,647	1,647	1,647	1,647	1,647
State and Private Land					
Potential habitat affected (acres)	N/A	18	67	73	58

N/A = Not applicable.
Numbers in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.
[1] Based on a home range size of 800 acres for general forest habitat and 175 acres for high-quality habitat.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts from Alternative 3 on black-backed woodpecker would be slightly less than Alternative 2. In the Crazy PSU, Alternative 3 would affect about 542 acres of general forest habitat and 261 acres of high-quality black-backed woodpecker habitat, reducing the PPI by 2 pairs to 57 nesting pairs (Table 176). The Alternative 3 tailings impoundment would result in the loss of 685 acres of potential habitat in one localized area, which could displace one or more nesting black-backed woodpecker pairs that may have traditionally used the area. Although no black-backed woodpecker nests were identified in the analysis area, surveys would be conducted in potential black-backed woodpecker habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts from Alternative 4 on black-backed woodpecker would be slightly more than Alternative 2. In the Crazy PSU, Alternative 4 would affect about 323 acres of general forest habitat and 627 acres of high-quality black-backed woodpecker habitat, reducing the PPI by 4 pairs to 55 nesting pairs (Table 176). The Alternative 4 tailings impoundment would result in the loss of 503 acres of potential habitat in one localized area, which could displace one or more nesting black-backed woodpecker pairs that may have traditionally used the area. Clearing restrictions and pre-construction surveys described for Alternative 3 also would apply for Alternative 4.

Alternative A – No Transmission Line

Impacts to black-backed woodpecker habitat resulting from the transmission line alternatives are shown in Table 177. The No Transmission Line Alternative would not impact black-backed woodpecker habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Both general forest and high-quality black-backed woodpecker habitat would be impacted by Alternative B in the Crazy and Silverfish PSUs, but impacts would be too small to change the PPI (Table 177). Alternative B would affect about 21 acres of general forest habitat and 12 acres of high-quality black-backed woodpecker habitat in the Crazy PSU, and about 14 acres of general forest habitat and 16 acres of high-quality black-backed woodpecker habitat in the Silverfish PSU. The Alternative B clearing area would include about 18 acres of coniferous forest providing potential black-backed woodpecker habitat. The quality of the black-backed woodpecker habitat on private land is unknown.

Several surveys conducted in the Crazy and Silverfish PSUs; no black-backed woodpecker nests were identified in the analysis area. As specified in the Environmental Specifications (Appendix D), either tree removal would not occur during black-backed woodpecker breeding season, or surveys would be conducted in potential black-backed woodpecker habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to black-backed woodpecker from Alternative C would be similar to Alternative B, affecting 3 fewer acres of high-quality habitat in the Crazy PSU, 1 acre more of high-quality habitat in the Silverfish PSU, and 49 more acres of potential habitat on private land. The quality of the black-backed woodpecker habitat on private land is unknown. Alternative C also would comply with the Environmental Specifications (Appendix D).

Alternative D – Miller Creek Transmission Line Alternative

Overall, Alternative D would have greater impacts on black-backed woodpecker habitat than Alternatives B and C, but impacts from Alternative D would be too small to change the PPI (Table 177). Alternative D would affect about 25 acres of general forest habitat and 13 acres of high-quality black-backed woodpecker habitat in the Crazy PSU, and about 8 acres of general forest habitat and 32 acres of high-quality black-backed woodpecker habitat in the Silverfish PSU. The Alternative D clearing area would include about 73 acres of coniferous forest providing potential black-backed woodpecker habitat. The quality of the black-backed woodpecker habitat on private land is unknown. Alternative D also would comply with the Environmental Specifications (Appendix D).

Alternative E – West Fisher Creek Transmission Line Alternative

Both general forest and high-quality black-backed woodpecker habitat would be impacted by Alternative E in the Crazy and Silverfish PSUs, Most of the impacts would occur to high-quality habitat in the Silverfish PSU, reducing the PPI by 1 nesting pair, or 2 percent (Table 177). Given the existing available habitat and PPI, impacts from Alternative E on black-backed woodpecker in the Crazy and Silverfish PSUs would be minor.

Combined Mine-Transmission Line Effects

Impacts to black-backed woodpecker habitat in the analysis area are shown in Table 178.

Impacts to black-backed woodpecker in the Crazy PSU would range from 344 to 567 acres of general forest foraging habitat and from 270 to 640 acres of high-quality habitat. Impacts in the Crazy PSU would be the greatest for Alternatives 4C, 4D, and 4E, resulting in a 4 percent reduction in PPI in the Crazy PSU. For all combined action alternatives, impacts to black-backed woodpecker in the Silverfish PSU would be due entirely to the transmission line. Impacts in the Silverfish PSU would range from 8 to 14 acres of general forest foraging habitat and 16 to 32 acres of high-quality habitat, and would not measurably affect the PPI. Overall, impacts in the Silverfish PSU would be greatest for Alternatives 3D, 3E, 4D, and 4E due to the length of the transmission line for these alternatives. Impacts to potential black-backed woodpecker habitat on state and private lands would range from 18 acres for Alternative B to 73 acres for Alternatives 3D and 4D. Despite several surveys conducted in the Crazy and Silverfish PSUs, no black-backed woodpecker nests were identified in the analysis area. Although the occupancy of the Crazy and Silverfish PSUs by nesting black-backed woodpeckers is not certain, the loss of potential habitat resulting from the combined action alternatives could reduce the quality of the habitat in these PSUs for nesting black-backed woodpeckers through increased habitat fragmentation, edge effects, and disturbance effects. For all alternatives, construction of the tailings impoundment would result in the loss of between 503 and 715 acres of potential habitat in one localized area, which could displace one or more nesting black-backed woodpecker pairs that may have traditionally used the area. In terms of PPI, the impacts of the combined action alternatives on black-backed woodpecker populations in the Crazy or Silverfish PSU would be minimal.

Table 178. Impacts to Black-backed Woodpecker Habitat in the Analysis Area by Combined Mine-Transmission Line Alternatives.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
	TL-A	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
General Forest Foraging Habitat (acres)	6,083	5,646 (-437)	5,520 (-563)	5,516 (-567)	5,516 (-567)	5,739 (-344)	5,735 (-348)	5,735 (-348)
High Quality Habitat (acres)	9,060	8,575 (-485)	8,790 (-270)	8,786 (-274)	8,786 (-274)	8,424 (-636)	8,420 (-640)	8,420 (-640)
PPI[1]	59	56	57	57	57	55	55	55
Silverfish PSU								
General Forest Foraging Habitat (acres)	7,479	7,465 (-14)	7,465 (-14)	7,471 (-8)	7,471 (-8)	7,465 (-14)	7,471 (-8)	7,471 (-8)
High Quality Habitat (acres)	7,958	7,942 (-16)	7,941 (-17)	7,926 (-32)	7,896 (-32)	7,941 (-17)	7,926 (-32)	7,896 (-32)
PPI[1]	55	55	55	55	54	55	55	54
KNF								
PPI	1,647	1,644	1,645	1,645	1,645	1,643	1,643	1,643
Private Land								
Potential habitat affected (acres)	N/A	18	67	73	58	67	73	58

N/A = Not applicable.
Number in parentheses is the decrease in habitat acres compared to existing conditions.
[1]Based on a home range size of 800 acres for general forest habitat and 175 acres for high-quality habitat.
Source: GIS analysis by ERO Resources Corp. using KNF data.

In all combined action alternatives, as described in the Environmental Specifications (Appendix D), either tree removal would not occur during black-backed woodpecker breeding season, or surveys would be conducted in potential black-backed woodpecker habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers. Alternative 2B does not include timing restrictions or black-backed woodpecker surveys of the mine disturbance area.

Cumulative Effects

Past actions, particularly timber harvest, road construction, fire suppression, and firewood gathering activities, have contributed to a reduction in potential black-backed woodpecker habitat (USDA Forest Service 2003b). Firewood cutting and gathering would continue to occur where open roads provide access to forest habitat, contributing to the removal of snags and down wood important for black-backed woodpeckers. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of potential black-backed woodpecker habitat in the analysis area.

The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. Timber harvest and other clearing activities planned for the Miller-West Fisher Vegetation Management Project in the Silverfish PSU would contribute to cumulative losses of snags and down wood important to black-backed woodpecker. Activities associated with the Miller-West Fisher Vegetation Management Project are expected to retain cavity habitat within KFP-recommended levels for the Silverfish PSU. Also, while prescribed burns associated with the Miller-West Fisher Vegetation Management Project would consume some snags and down wood, it also would create snags and down wood by killing live trees. Snags and down wood created in burned areas would provide both feeding and nesting habitat for the black-backed woodpecker. Other reasonably foreseeable actions would involve minimal disturbance to snags and down wood. The No Action alternatives (Alternative 1 and Alternative A) would not contribute to cumulative impacts to the black-backed woodpecker. In combination with other reasonably foreseeable actions, the combined mine-transmission line alternatives would likely have minor impacts on black-backed woodpeckers and would probably not affect black-backed woodpecker populations in either PSU or in the KNF.

3.24.4.3.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6). All alternatives would meet this direction for the black-backed woodpecker.

All action alternatives would be consistent with KFP direction for snags and down wood (see section 3.24.2, *Key Habitats*). In all combined mine-transmission line alternatives, a wide range of successional habitats, and associated amounts of down wood would be available. The action alternatives would be consistent with KFP direction to maintain diverse age classes of vegetation for viable populations (KFP Vol. 1, II-1 #7).

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives may impact individuals and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability for the black-backed woodpecker. This determination is based on: 1) the mine alternatives would have no impact on black-backed woodpeckers in the Silverfish PSU; 2) the combined action alternatives would result in habitat loss and the reduction of the black-backed woodpecker PPI in the Crazy PSU of 2 to 4 nesting pairs; 3) the combined action alternatives would result in habitat loss but would not change the PPI in the Silverfish PSU; and 4) no black-backed woodpeckers have been observed in the Crazy or Silverfish PSU, despite several recent surveys. While some individuals could be affected, given the availability of habitat, these impacts would not affect black-backed woodpecker populations in either the Crazy or Silverfish PSU or the KNF.

3.24.4.4 Coeur D'Alene Salamander

3.24.4.4.1 Analysis Area and Methods

Coeur d'Alene salamander population ecology, biology, habitat description, and relationships identified by research are described in Cassirer *et al.* (1994) and Maxell (2000). That information is incorporated by reference. Coeur d'Alene salamander occurrence data come from recent District wildlife observation records and KNF historical data (NRIS FAUNA), MNHP, and other agencies, such as FWP. Because the only area in the Crazy or Silverfish PSU potentially affected by the proposed project where the Coeur d'Alene salamander could potentially occur is adjacent to Bear Creek Road (NFS road #278), the analysis of potential impacts of the proposed project on individuals of this species or their habitat is limited to this area. The analysis area for cumulative effects is the Crazy PSU.

The impacts analysis includes an evaluation of the benefits to the Coeur d'Alene salamander from mitigation measures proposed by MMC or the agencies described in sections 2.4.6, Mitigation Plans and 2.5.7, Mitigation Plans or Appendix D, such as wetlands mitigation and implementation of BMPs, and riparian and water quality standards.

3.24.4.4.2 Affected Environment

The Coeur d'Alene salamander has been found below 5,000 feet in western Montana and is the only species of lungless salamander in the northern Rocky Mountain region (Cassirer *et al.* 1994). The salamander is associated with seepages, waterfalls, and small creeks near talus with fractured rock and with dense overstory canopies (Werner *et al.* 2004).

Johnson (1999) shows Coeur d'Alene salamander confirmed presence in four of the eight planning units on the KNF at 13 different sites. The salamander has been confirmed in two additional planning units since 1999 and the known sites now total 36. Known populations on the KNF are isolated by miles of unsuitable habitat that cannot be crossed (Maxell 2000; Maxell *et al.* 2003).

Historical records show that Coeur d' Alene salamanders were observed prior to 1990 adjacent to the Bear Creek Road (NFS road #278) on the northeast side of Big Hoodoo Mountain, and adjacent to the Libby Creek Road (NFS road #231) about 1.5 miles northeast of MMC's proposed Little Cherry Creek Impoundment. Despite recent surveys, no recent observations of the Coeur d'

Alene salamander in the Crazy and Silverfish PSUs have been recorded, and recent field work within these areas suggest the habitat has been degraded and is atypical of Coeur d' Alene salamander habitat (Westech 2005a).

3.24.4.4.3 Environmental Consequences

Impacts of the mine alternatives on the Coeur d' Alene salamander are described below. The transmission line alternatives would not affect the Coeur d' Alene salamander and are not included in the analysis.

Alternative 1 – No Mine

Alternative 1 would not disturb Coeur D'Alene salamanders or their habitat and would have no effect on this species.

Alternative 2 – MMC's Proposed Mine

According to Maxell (2000), the greatest threats to the Coeur d'Alene salamander are timber harvest, fire, road and trail development and maintenance, vehicle use on roads, and isolation of populations. Widening and improvement of the Bear Creek Road (NFS road #278) could impact small amounts of potential Coeur d'Alene salamander habitat. Some incidental mortality could occur due to forest clearing and increased traffic associated with Alternative 2. Impacts to the Coeur d'Alene salamander are not likely to occur because none have been recently observed in the analysis area and habitat in the analysis area does not appear to provide characteristics typically favored by this species. In addition, any adverse effects to wetlands or riparian habitat occurring in potential Coeur d'Alene salamander habitat would be minimized or avoided through implementation of BMPs and riparian and water quality standards, and compliance with the Clean Water Act. Any wetlands affected would be replaced with wetlands with similar functions and values.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to the Coeur d'Alene salamander from Alternative 3 would be the same as Alternative 2.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to the Coeur d'Alene salamander from Alternative 4 would be the same as Alternative 2.

Cumulative Effects

Alternative 1 would not have cumulative impacts on the Coeur d'Alene salamander. The mine alternatives would not likely affect, and would not contribute to cumulative effects, to the Coeur d'Alene salamander. No other reasonably foreseeable actions would affect any known locations of Coeur d'Alene salamander; cumulative impacts to this species would be negligible.

3.24.4.4.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6); all mine alternatives meet KFP direction.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). The combined mine-transmission line alternatives would not likely impact individuals and/or their habitat, and would not contribute to a trend toward federal listing or loss of species viability for the Coeur d'Alene salamander. This determination is based on 1) no Coeur d'Alene salamanders have been recently observed in the analysis area; 2) habitat in the analysis area does not appear to provide characteristics typically favored by this species; and 3) any adverse effects to wetlands or riparian habitat occurring in potential Coeur d'Alene salamander habitat would be minimized or avoided through implementation of BMPs and riparian and water quality standards, and compliance with the Clean Water Act. As described in sections 2.4.6.1, *Wetland Mitigation Plan* and 2.5.7.1, *Wetland Mitigation*, any wetlands affected would be replaced with wetlands with similar functions and values.

3.24.4.5 Fisher

3.24.4.5.1 Analysis Area and Methods

Fisher population ecology, biology, habitat description and relationships identified by research are described in Powell and Zielinski (1994) and Heinemeyer and Jones (1994). That information is incorporated by reference. Fisher occurrence data come from recent District wildlife observation records and KNF historical data (NRIS FAUNA) and other agencies, such as the FWP. Potential fisher habitat was estimated based on the KNF CEM and the TSMRS vegetation data (see KNF project record). The number of male or female fishers potentially supported by a given area, referred to as the potential population index (PPI), was estimated by dividing total habitat by average home range, based on an average male fisher home range of 10,000 acres, and an average female fisher home range of 3,700 acres (Powell and Zielinski 1994). The index includes both male and female fishers because their home ranges overlap extensively (ibid.). The analysis area for project impacts to individuals and their habitat in the KNF consists of the Crazy and Silverfish PSUs. To evaluate potential direct and indirect impacts of the transmission line on fishers, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. The analysis area for cumulative effects is the KNF and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The analysis area includes private and state lands crossed by the eastern portions of the alternative transmission line alignments. Specific fisher habitat information is not available for private or state-owned lands in the analysis area, much of which has been logged in the past 20 to 30 years. Fisher habitat on private land was estimated based on mapping of coniferous forest shown on Figure 83 and old growth shown on Figure 84 and likely past and current land use practices.

The impacts analysis includes an evaluation of the benefits to fisher from mitigation measures proposed by MMC or the agencies described in sections 2.4.6, *Mitigation Plans* and 2.5.7, *Mitigation Plans* or Appendix D, such as wetlands mitigation and minimization of impacts to riparian habitat.

3.24.4.5.2 Affected Environment

In the western United States, fishers prefer late-successional forests (mature or old growth forests), and low elevation, moist riparian corridors for resting, denning, and travel (Heinemeyer

and Jones 1994). The fisher feeds on a variety of prey, from small to medium-sized mammals, birds, and carrion (Powell and Zelinski 1994). Fishers use an assortment of habitats for feeding, although they avoid non-forested areas (Jones and Garton, and Roy *In* Ruggiero *et al.* 1994).

In the western United States, fisher populations are limited to certain mountain ranges in the Pacific Northwest and Rocky Mountains. These isolated populations may be acutely susceptible to local extinction (Heinemeyer and Jones 1994). Fishers once occurred in the Cabinet Mountains, but were eliminated locally by overtrapping and habitat alteration (Ruggiero *et al.* 1994; Vinkey *et al.* 2006). Between 1989 and 1991, 110 fishers from the Midwest were released in the Cabinet Mountains as part of a state translocation program. Vinkey (2003) studied the distribution of fishers in the Cabinet Mountains using winter snow tracking, track plates, and live-trapping surveys conducted from 2001 to 2003. All verified records of fishers from this study were from the west Cabinet Mountains. Vinkey (2003) concluded that the introduction of fishers to the Cabinet Mountains has established a small population, but that the long-term viability of this population is uncertain. The KNF provides suitable fisher habitat, but both current and historical information suggests that fisher have never been abundant in the Cabinet Mountains (Heinz 1996; Vinkey 2003). The current population of fishers in the Cabinet Mountains is unknown. Fishers are generally more common where human density is low and human disturbance is reduced (Ruggiero *et al.* 1994).

Johnson (1999) shows fisher presence confirmed in five of the eight planning units on the KNF. Fisher observation and monitoring data indicates that suitable habitat is present within the analysis area, especially along forested streams. There have been no recent (since 2000) sightings of fishers within the analysis area, but historical observations have been recorded within the Crazy and Silverfish PSUs. A fisher den was found in 1989 near Horse Mountain (Roy 1991). Fishers are known to be present within the Libby Creek drainage, and are possibly present within the Poorman Creek, Ramsey Creek, and West Fisher Creek drainages (Westech 2005a).

Ruediger (1994) shows the KNF as a primary habitat area for fisher. Based on habitat modeling, 9,077 and 8,172 acres of potential fisher habitat occur in the Crazy and Silverfish PSUs, respectively. The Crazy PSU is within the Kootenai planning unit, and the Silverfish PSU is within the Fisher planning unit. Following the identification process outlined in Ruediger (1994), these planning units are designated as secondary fisher conservation areas (Johnson 2004b). The Crazy and Silverfish PSUs are considered high-quality fisher habitat areas (Id.).

Based on the average male and female fisher home range sizes, the PPI for each of the Crazy and Silverfish PSUs is 2 female and 1 male fisher. Based on potential yearlong habitat (Johnson 1999), the minimum PPI for the KNF would be 29 male and 80 female fishers.

Old growth habitat on private and state land in the analysis area consists mostly of cottonwood/ spruce riparian habitat. The majority of the non-National Forest System lands in the analysis area have high road densities and have been logged in the past 20 to 30 years (Figure 83), resulting in fragmented forest habitat. Potential fisher habitat on private and state lands is likely of marginal quality.

3.24.4.5.3 Environmental Consequences

Impacts to fisher from mine and transmission line alternatives are shown in Table 179 and Table 180 and are described in the following subsections. Impacts from the mine alternatives would not affect fishers in the Silverfish PSU and are not displayed in Table 179.

Table 179. Fisher Habitat in the Crazy PSU and the KNF by Mine Alternative.

Measurement Criteria	[1] No Mine/Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment	[4] Agency Mitigated Little Cherry Creek Impoundment
Crazy PSU				
Fisher Habitat (acres)	9,077	8,737 (-340/-4)	8,822 (-255/-3)	8,846 (-231/-3)
PPI (Males) [1]	1	1	1	1
PPI (Females) [1]	2	2	2	2
KNF				
Fisher Habitat (acres)	294,531	294,191 (-340/<-1)	294,276 (-255/<-1)	294,300 (-231/<-1)
PPI (Males) [1]	29	29	29	29
PPI (Females) [1]	80	80	80	80

Number in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.

[1] Based on an average male fisher home range of 10,000 acres and an average female fisher home range of 3,700 acres.

Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 180. Effects on Fisher Habitat in the Analysis Area by Transmission Line Alternative.

Measure-ment Criteria	[A] No Transmission Line/ Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
Crazy PSU					
Fisher Habitat (acres)	9,077	9,049 (-28/<-1)	9,065 (-12/<-1)	9,060 (-17/<-1)	9,060 (-17/<-1)
PPI (Males) [1]	1	1	1	1	1
PPI (Females) [1]	2	2	2	2	2
Silverfish PSU					
Fisher Habitat (acres)	8,172	8,172 (0)	8,172 (0)	8,164 (8/<-1)	8,159 (13/<-1)
PPI (Males) [1]	1	1	1	1	1
PPI (Females) [1]	2	2	2	2	2
KNF					
Fisher Habitat (acres)	294,531	294,503 (-28/<-1)	294,519 (-12/<-1)	294,506 (-25/<-1)	294,501 (-30/<-1)
PPI (Males) [1]	29	29	29	29	29
PPI (Females) [1]	80	80	80	80	80
Private and State Land					
Coniferous forest affected (acres)	0	18	67	73	58
Old growth affected (acres)	0	4	2	2	6

Number in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.
[1] Based on an average male fisher home range of 10,000 acres and an average female fisher home range of 3,700 acres.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 1 – No Mine

Alternative 1 would not impact the fisher or its habitat (Table 179).

Alternative 2 – MMC's Proposed Mine

No impacts to fisher would occur as a result of Alternative 2 in the Silverfish PSU. Alternative 2 would reduce the amount of fisher habitat in the Crazy PSU by 340 acres, mostly in the Little Cherry Creek Tailings Impoundment Site, but these impacts would be too small to change the existing PPI (Table 179). The risk of fisher mortality would increase as a result of increased traffic and increased winter access to fisher habitat from Alternative 2. Alternative 2 would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program, and while the Bear Creek Road is reconstructed, allowing trappers easy winter access to old growth and riparian areas providing good fisher habitat. Increased traffic could result in more fishers being killed by vehicles, although traffic increases are anticipated to be minimal (see section 3.20, *Transportation*). While research does not show fisher to be highly

sensitive to human activity, disturbance effects could occur due to the presence of people and machines during construction and operations, potentially displacing fishers from nearby suitable habitat. Displacement effects would probably be the greatest during the construction phase, but would continue at lower levels during operations. According to Heinemeyer and Jones (1994), the most sensitive time for fishers is the breeding, denning, and rearing period (February 15 to June 30). Impacts within 200 meters of perennial streams are especially important to avoid (ibid.). Impacts of Alternative 2 on riparian fisher habitat would be minimized through implementation of MMC's proposed Wetland Mitigation Plan (section 2.4.6.1, *Wetland Mitigation Plan*) and the Environmental Specifications (Appendix D).

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to fisher from Alternative 3 would be the same as Alternative 2, except that less fisher habitat would be affected (255 acres) (Table 179). Impacts of Alternative 3 on riparian fisher habitat would be minimized through implementation of the agencies' proposed Wetland Mitigation Plan (section 2.5.7.1, *Wetland Mitigation*) and the Environmental Specifications (Appendix D).

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to fisher from Alternative 4 would be the same as Alternative 2, except that less fisher habitat would be affected (231 acres) (Table 179).

Alternative A – No Transmission Line

Table 180 summarizes the changes in habitat and PPI due to each alternative. Alternative A would not impact fisher habitat or PPI.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

No impacts to fisher would occur as a result of Alternative B in the Silverfish PSU. Alternative B would reduce the amount of fisher habitat in the Crazy PSU by 28 acres, but these impacts would be too small to change the existing PPI (Table 180). The risk of fisher mortality could increase as a result of increased traffic from Alternative B, although traffic increases are anticipated to be minimal (see section 3.20, *Transportation*). While research does not show fisher to be highly sensitive to human activity, disturbance effects could occur due to the presence of people and machines during transmission line construction, potentially displacing fishers from nearby suitable habitat. According to Heinemeyer and Jones (1994), the most sensitive time for fishers is the breeding, denning, and rearing period (February 15-June 30). Displacement effects would be negligible during operations because activities would be limited to line maintenance. Impacts of Alternative B on riparian fisher habitat would be reduced through implementation of MMC's proposed Wetland Mitigation Plan (section 2.4.6.1, *Wetland Mitigation Plan*), and the Environmental Specifications (Appendix D).

Alternative B would affect about 18 acres of coniferous forest and 4 acres of old growth providing fisher habitat on private land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to fisher from Alternative C on National Forest System land would be similar to Alternative B, except that less fisher habitat (12 acres) would be impacted. Impacts of Alternative

C on riparian fisher habitat would be minimized through implementation of the agencies' Wetland Mitigation Plan (section 2.5.7.1, *Wetland Mitigation*), the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D).

Alternative C would affect about 67 acres of coniferous forest and 2 acres of old growth forest providing potential fisher habitat on private land. Because habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative D – Miller Creek Transmission Line Alternative

Impacts to fisher from Alternative D on National Forest System land would be similar to Alternative C, except that more fisher habitat (25 acres) would be impacted.

Alternative D would affect about 73 acres of coniferous forest and 2 acres of old growth providing habitat fisher on private land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative E – West Fisher Creek Transmission Line Alternative

Impacts to fisher from Alternative E on National Forest System land would be similar to Alternative C except that more fisher habitat (30 acres) would be impacted.

Alternative E would affect about 58 acres of coniferous forest and 6 acres of old growth providing fisher habitat fisher on private and state land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Combined Mine-Transmission Line Effects

Alternative 2B would have the greatest impacts to fisher habitat in the Crazy PSU (impacting 368 acres) followed by Alternatives 3D and 3E (impacting 272 acres) (Table 181). Alternative 4C would affect the fewest acres of fisher habitat (243 acres) in the Crazy PSU. Alternatives 2B, 3C, and 3D would not impact fisher habitat in the Silverfish PSU. Impacts to fisher habitat in the Silverfish PSU for the other combined mine transmission line alternatives would range from 8 to 13 acres. None of the combined mine-transmission line alternatives would result in measurable changes to the fisher PPI in the Crazy or Silverfish PSU or the KNF.

In all combined action alternatives, the risk of fisher mortality would increase as a result of increased traffic and increased access to fisher habitat, although traffic increases are anticipated to be minimal (see section 3.20, *Transportation*). All combined action alternatives would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, providing trappers easy winter access to fisher habitat in old growth and riparian areas. While research does not show fishers to be highly sensitive to human activity, disturbance effects could occur due to the presence of people and machines during transmission line construction, potentially displacing fishers from nearby suitable habitat. According to Heinemeyer and Jones (1994), the most sensitive time for fisher is the breeding, denning, and rearing period (February 15 to June 30). In all combined action alternatives, impacts on riparian fisher habitat would be reduced through implementation of implementation of MMC's proposed Wetland Mitigation Plan (see Chapter 2), the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D).

Table 181. Fisher Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Fisher Habitat (acres)	9,077	8,709 (-368)	8,810 (-267)	8,805 (-272)	8,805 (-272)	8,843 (-243)	8,829 (-248)	8,829 (-248)
PPI (Males) [1]	1	1	1	1	1	1	1	1
PPI (Females) [1]	2	2	2	2	2	2	2	2
Silverfish PSU								
Fisher Habitat (acres)	8,172	8,172 (0)	8,172 (0)	8,164 (-8)	8,159 (-13)	8,172 (0)	8,164 (-8)	8,159 (-13)
PPI (Males) [1]	1	1	1	1	1	1	1	1
PPI (Females) [1]	2	2	2	2	2	2	2	2
KNF								
Fisher Habitat (acres)	294,531	294,163 (-368)	294,264 (-267)	294,251 (-280)	294,246 (-285)	294,288 (-243)	294,275 (-256)	294,270 (-261)
PPI (Males) [1]	29	29	29	29	29	29	29	29
PPI (Females) [1]	80	80	80	80	80	80	80	80
Private and State Land								
Coniferous forest affected (acres)	0	18	67	73	58	67	73	58
Old growth affected (acres)	0	4	2	2	6	2	2	6

Number in parentheses is the decrease in habitat acres compared to existing conditions.
[1] Based on an average male fisher home range of 10,000 acres and an average female fisher home range of 3,700 acres.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Impacts to coniferous forest on state and private land would range from 18 acres for Alternative 2B to 73 acres for Alternatives 3D and 4D. Impacts to old growth on private land would range from 2 acres for Alternatives 3C, 3D, 4C, and 4D to 6 acres for Alternatives 3E and 4E. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; increases in tree density, and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of fisher habitat in the analysis area. Impacts to fisher on private and state lands would probably be minimal because it is likely that fisher habitat in these areas is of marginal quality.

Alternative 1A would not have cumulative impacts on the fisher. Regeneration harvest, prescribed burns, and other forest treatments proposed for the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, could contribute to cumulative losses and fragmentation of fisher habitat. The Miller-West Fisher Vegetation Management Project would not directly impact old growth that could provide potential fisher habitat. Surface impacts from other reasonably foreseeable actions in the analysis area would be minimal. While combined action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of fisher habitat, cumulative impacts on overall amounts of fisher habitat would not likely result in a measurable change in fisher PPI. In addition, mitigation associated with combined agencies' alternatives would increase the proportion of designated old growth and promote the maintenance or development of fisher habitat in the analysis area.

Other cumulative effects from the action alternatives and other reasonably foreseeable actions include an increased risk of fisher mortality due to increased trapping. For the combined action alternatives, traffic volumes and speeds may cumulatively be greater in the Miller Creek and West Fisher Creek drainages and near main access roads (see section 3.20, *Transportation*), resulting in an increased risk of fisher mortality from vehicle collisions. For the transmission line alternatives, cumulative traffic increases would occur primarily during the construction period and would be short-term. Cumulative traffic increases for the mine alternatives would be long-term and would last through the reclamation phase. Vehicle collisions with fishers could be prevented or reduced by installing wildlife crossing signs or reducing speed limits on roads used for the Montanore Project.

Cumulative impacts could be offset by habitat acquisitions and road access changes associated with grizzly bear mitigation for the Montanore Project and other reasonably foreseeable actions.

3.24.4.5.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental

needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this direction for the fisher.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual fishers and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability for the fisher. This determination is based on: 1) the mine alternatives would have no impact on fishers in the Silverfish PSU; 2) all combined action alternatives would result in the direct loss of fisher habitat, but these impacts represent less than 1 percent of potential fisher habitat; 3) none of the combined action alternatives would result in measurable changes to the fisher PPI in the Crazy or Silverfish PSU or the KNF; 4) all action alternatives could result in an increase in the risk of fisher mortality due to increased traffic and winter access to fisher habitat; 5) all action alternatives would result in increased habitat fragmentation and disruption of movement in riparian corridors, and potential displacement from suitable habitat due to human disturbance; and 6) all combined mine-transmission line alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth (fisher habitat) below 5,500 feet in elevation. While some individuals could be affected, impacts would not be severe enough to limit fisher recovery. Given the availability of habitat, these impacts would not affect fisher populations in either the Crazy or Silverfish PSU or the KNF.

3.24.4.6 Flammulated Owl

3.24.4.6.1 Analysis Area and Methods

Flammulated owl population ecology, biology, habitat description, and relationships identified by research are summarized in Hayward and Verner (1994). More recent research on nesting, food habits, home range and territories, and habitat quality conducted in Colorado, Idaho, and Montana is discussed in Linkhart (2001), Linkhart and Reynolds (1997), Linkhart *et al.* (1998), Powers *et al.* (1996), Wright (1996), and Wright *et al.* (1997). That information is incorporated by reference. Flammulated owl occurrence data come from recent District wildlife observation records and KNF historical data (NRIS FAUNA). Potential flammulated owl habitat was estimated based on the KNF Cumulative Effects Model (CEM) and TSMRS vegetation data, and the KNF CEM flammulated owl habitat model (see KNF project record).

The number of potential flammulated owl breeding pair territories, referred to as the potential population index (PPI), was estimated based on dividing the amount of habitat by an average home range size of 40 acres (Hayward and Verner 1994). Effects of the alternatives were evaluated based on changes in habitat and PPI.

The analysis area for project impacts and cumulative effects to individuals and their habitat consists of the Crazy and Silverfish PSUs. The analysis area includes private and state lands crossed by the eastern portions of the alternatives transmission line alignments. Specific flammulated owl habitat information is not available for private or state-owned lands in the analysis area, much of which has been logged in the past 20 to 30 years. Flammulated owl habitat on private land was estimated based on mapping of coniferous forest shown on Figure 83 and likely past and current land use practices.

The impacts analysis includes an evaluation of the potential benefits to flammulated owls from mitigation measures proposed by MMC or the agencies described in sections 2.4.6 and 2.5.7, *Mitigation Plans* and Appendix D, such as implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), flammulated owl surveys and, if appropriate, the establishment of avoidance areas where tree removal would not occur.

3.24.4.6.2 Affected Environment

Flammulated owl habitat consists of mature and old-growth xeric ponderosa pine and Douglas fir stands with low to moderate canopy closure (MNHP 2008). Flammulated owls typically nest in cavities excavated by other cavity-nesting birds (ibid.). The KNF provides about 237,098 acres of potential flammulated owl habitat and potential flammulated owl habitat occurs across all eight planning subunits (Johnson 1999). Field surveys have confirmed flammulated owl presence in six of eight planning units. The owl population size on the KNF is unknown (ibid.). Flammulated owl surveys using taped owl calls to draw a response from nesting birds have been conducted intermittently within the Crazy and Silverfish PSUs over the last decade. According to District flammulated owl observation and monitoring data, the species has been observed on numerous occasions in the past 13 years in the North Fork Miller Creek and the Miller Creek drainages. No observations of flammulated owls have been recorded within the Crazy PSU. No flammulated owls were found during surveys conducted in 2005 (Westech 2005a) in the Crazy and Silverfish PSUs.

Based on the potential nesting habitat acres from Johnson (1999), the minimum PPI for the KNF is 5,927 flammulated owl pairs. Based on habitat modeling, about 11,902 acres of potential flammulated owl habitat occur in the Crazy PSU, and 10,786 acres in the Silverfish PSU. Based on the average flammulated owl pair territory size, the PPI for the National Forest System lands within the Crazy and Silverfish PSUs is 298 and 270 flammulated owl pairs, respectively. These estimates of PPI are considered high based on actual survey results.

The majority of the non-National Forest System lands in the analysis area have high road densities and have been logged in the past 20 to 30 years (Figure 83), resulting in loss of snags and fragmented forest habitat. Coniferous forest on private lands is primarily dominated by dry ponderosa pine/Douglas-fir communities.

3.24.4.6.3 Environmental Consequences

Impacts to flammulated owls from mine and transmission line alternatives are shown in Table 182 and Table 183, and are described in the following subsections. Impacts from the mine alternatives would not affect flammulated owls in the Silverfish PSU and are not displayed in Table 182.

Alternative 1 – No Mine

Impacts to potential flammulated owl habitat caused by the mine alternatives are shown in Table 182. Alternative 1 would not impact flammulated owls or their habitat.

Alternative 2 – MMC's Proposed Mine

Alternative 2 would reduce the amount of flammulated owl habitat in the Crazy PSU by 343 acres, or 3 percent, and would change the PPI to 289 pairs (Table 182).

Table 182. Flammulated Owl Habitat in the Crazy PSU and the KNF by Mine Alternative.

Measurement Criteria	[1] No Mine/Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment	[4] Agency Mitigated Little Cherry Creek Impoundment
Crazy PSU				
Flammulated Owl Habitat (acres)	11,902	11,559 (-343/-3)	11,714 (-188/-2)	11,690 (-212/-2)
PPI[1] (pairs)	298	289	293	292
KNF				
Flammulated Owl Habitat (acres)	237,098	236,755 (-343/<-1)	236,910 (-188/<-1)	236,886 (-212/<-1)
PPI[1] (pairs)	5,927	5,919	5,923	5,922

Number in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.
[1] Based on an average flammulated owl home range size of 40 acres, rounded to nearest whole number. Due to rounding, KNF PPI may not be the result of direct subtraction of PPI impacts displayed.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 183. Effects on Flammulated Owl Habitat in the Analysis Area by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek)	[C] Modified North Miller Creek Transmission Line	[D] Miller Creek Transmission Line	[E] West Fisher Creek Transmission Line
Crazy PSU					
Flammulated Owl Habitat (acres)	11,902	11,878 (-24/<-1)	11,894 (-8/<-1)	11,889 (-13/<-1)	11,889 (-13/<-1)
PPI[1] (pairs)	298	297	297	297	297
Silverfish PSU					
Flammulated Owl Habitat (acres)	10,786	10,778 (-8/<-1)	10,768 (-18/<-1)	10,786 (0/0)	10,706 (-80/<-1)
PPI[1] (pairs)	270	269	269	270	268
KNF					
Flammulated Owl Habitat (acres)	237,098	237,066 (-32/<-1)	237,072 (-26/<-1)	237,085 (-13/<-1)	237,005 (-93/<-1)
PPI[1] (pairs)	5,927	5,927	5,927	5,927	5,925
Private and State Land					
Coniferous forest affected (acres)	0	18	67	73	58

Number in parentheses is the decrease in habitat acres/percent change in habitat area compared to existing conditions.
[1] Based on an average flammulated owl home range size of 40 acres, rounded to nearest whole number. Due to rounding, KNF PPI may not be the result of direct subtraction of PPI impacts displayed.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 2 would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.24.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this species. If reclamation were successful, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Noise and other human-caused disturbances, such as blasting, construction of the plant and adit sites, road construction and use, and plant and adit operations could cause flammulated owls to avoid nearby habitat, at least temporarily. Disturbance impacts would likely be greatest during the construction phase, but could persist through mine operations.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), because potential flammulated owl habitat occurs in the analysis area, Alternative 2 could result in the destruction of nests or nest abandonment by flammulated owls.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would affect less flammulated owl habitat than Alternatives 2 and 4. Alternative 3 would reduce the amount of flammulated owl habitat in the Crazy PSU by 188 acres, or 3 percent, and would change the PPI to 293 pairs (Table 182).

Alternative 3 would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.24.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this species. Implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize impacts to snags providing potential nesting and foraging habitat for flammulated owls. If reclamation were successful, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in section 2.5.7.3, *Wildlife Mitigation*, surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting flammulated owls.

Disturbance impacts to flammulated owls would be the same for Alternative 3 as Alternative 2.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to flammulated owl from Alternative 4 would be the same as Alternative 3, except that less habitat would be affected (212 acres, or a 2 percent decrease) (Table 182). The PPI would be reduced by 6 flammulated owl pairs as a result of Alternative 4 impacts.

Alternative A – No Transmission Line

Impacts to potential flammulated owl habitat caused by the transmission line alternatives are shown in Table 183. Alternative A would not impact flammulated owl habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would reduce the amount of flammulated owl habitat in the Crazy and Silverfish PSUs by 24 and 8 acres, respectively. These impacts would represent less than 1 percent of the flammulated owl habitat in each PSU, and would change the PPI in each PSU by one flammulated owl pair (Table 183).

Alternative B would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.24.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this owl. If reclamation were successful and successional processes were allowed to take place, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in the Environmental Specifications (Appendix D), surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting flammulated owls.

Alternative B would affect about 18 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative B would be minimal.

Noise from helicopters during line stringing and from other construction-related activities could cause flammulated owls to avoid nearby habitat, at least temporarily. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would reduce the amount of flammulated owl habitat in the Crazy and Silverfish PSUs by 8 and 18 acres, respectively. These impacts would represent less than 1 percent of the flammulated owl habitat in each PSU, and would change the PPI in each PSU by one flammulated owl pair (Table 183).

Alternative C would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.24.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this owl. Implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize impacts to snags providing potential nesting and foraging habitat for flammulated owls. If reclamation were successful and successional processes were allowed to take place, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in the Environmental Specifications (Appendix D), surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting flammulated owls.

Alternative C would affect about 67 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative C would be minimal. Disturbance impacts to flammulated owls would be the same for Alternative C as Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

There would be no direct impacts from Alternative D to flammulated owl habitat in the Silverfish PSU. Alternative D impacts to flammulated owl in the Crazy PSU would be the same as

Alternative C, except that slightly more flammulated owl habitat (13 acres) would be impacted by Alternative D.

Alternative D would affect about 73 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative D would be minimal. Disturbance impacts to flammulated owls would be the same for Alternative D as Alternative B.

Alternative E – West Fisher Creek Transmission Line Alternative

Alternative E impacts to flammulated owl would be the same as Alternative D in the Crazy PSU. Due to the length of the transmission line, Alternative E would have the greatest impacts to flammulated owl habitat (80 acres) in the Silverfish PSU (Table 183). PPI in the Silverfish PSU would be reduced by two flammulated owl pairs. Disturbance impacts to flammulated owls would be the same for Alternative E as Alternative B.

Combined Mine-Transmission Line Effects

Impacts to flammulated owls from the combined mine-transmission line alternatives are shown in Table 184 and described below. Alternative 2B would have the greatest impacts to flammulated owl habitat in the Crazy PSU, impacting 367 acres, followed by Alternatives 3D and 3E, which would affect 225 acres. Alternative 4C would affect the fewest acres of flammulated owl habitat (196 acres) in the Crazy PSU. Alternatives 2B, 3D, and 4D would not impact flammulated owl habitat in the Silverfish PSU. Impacts to flammulated owl habitat in the Silverfish PSU for the other combined action alternatives would range from 8 to 80 acres. All of the combined action alternatives would reduce PPI in the Crazy and Silverfish PSUs. Reductions in overall flammulated owl PPI in the KNF would range from 5 to 9 pairs. All combined action alternatives could impact individual flammulated owls and their habitat, but sufficient habitat would remain in the analysis area to support a large number of nesting pairs. Mitigation associated with combined agencies' alternatives would increase the proportion of designated old growth and promote the maintenance or development of flammulated owl habitat in the analysis area.

All of the combined action alternatives would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.24.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this owl. For the combined agencies' alternatives, implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize impacts to snags providing potential nesting and foraging habitat for flammulated owls, especially in the transmission line clearing area. If reclamation were successful and successional processes were allowed to take place, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

In all combined action alternatives, noise from helicopters during line stringing and from other construction-related activities could cause flammulated owls to avoid nearby habitat, at least temporarily. Disturbance impacts from blasting and helicopters would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning. Disturbance impacts during mine operations would probably be lower in intensity, but would last through the life of the mine.

Table 184. Flammulated Owl Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Flammulated Owl Habitat (acres)	11,902	11,535 (-367)	11,706 (-196)	11,701 (-201)	11,701 (-201)	11,682 (-220)	11,677 (-225)	11,677 (-225)
PPI[1] (pairs)	298	288	293	293	293	292	292	292
Silverfish PSU								
Flammulated Owl Habitat (acres)	10,786	10,778 (-8)	10,768 (-18)	10,786 (0)	10,706 (-80)	10,768 (-18)	10,786 (0)	10,706 (-80)
PPI[1] (pairs)	270	269	269	270	268	269	270	268
KNF								
Flammulated Owl Habitat (acres)	237,098	236,723 (-375)	236,884 (-214)	236,897 (-201)	236,817 (-281)	236,860 (-238)	236,873 (-225)	236,793 (-305)
PPI[1] (pairs)	5,927	5,918	5,922	5,922	5,920	5,922	5,922	5,920
Private and State Land								
Coniferous forest affected (acres)	0	18	67	73	58	67	73	58

Number in parentheses is the decrease in habitat acres compared to existing conditions.
[1] Based on an average flammulated owl home range size of 40 acres, rounded to nearest whole number. Due to rounding, KNF PPI may not be result of direct subtraction of PPI impacts displayed.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in the Environmental Specifications (Appendix D) in all combined action alternatives, either tree removal would not occur during flammulated owl breeding season, or surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting flammulated owls. Alternative 2B does not include timing restrictions or flammulated owl surveys of the mine disturbance area.

Impacts to coniferous forest on state and private land would range from 18 acres for Alternative 2B to 73 acres for Alternatives 3D and 4D. Because flammulated owl habitat on private land is highly fragmented, impacts of the combined action alternatives would be minimal.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; increases in tree density; and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provide access to old growth habitat, contributing to the removal of snags important to flammulated owls. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of flammulated owl habitat in the analysis area. Impacts to flammulated owl on private and state lands would probably be minimal because it is highly fragmented due to high road densities and past timber harvest activities.

The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. Timber harvest and other clearing activities planned for the Miller-West Fisher Vegetation Management Project would contribute to cumulative losses of snags important to flammulated owls in the Silverfish PSU. Activities associated with the Miller-West Fisher Vegetation Management Project are expected to retain cavity habitat within KFP-recommended levels for the Silverfish PSU. Regeneration harvest included in the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, would not directly affect old growth providing potential flammulated owl habitat. Also, while prescribed burns associated with the Miller-West Fisher Vegetation Management Project would consume some snags, it also would create snags by killing live trees. Snags and down wood created in burn areas would provide both feeding and nesting habitat for flammulated owls. Other reasonably foreseeable actions would involve minimal surface disturbance.

Alternative 1A would not contribute to cumulative losses of snags and would not contribute to cumulative effects on flammulated owl. While the combined action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of flammulated owl habitat and cumulative reductions in flammulated owl PPI in the analysis area, cumulative impacts on overall amounts of flammulated owl habitat would likely be minimal and would not likely affect populations in the KNF. Sufficient habitat would remain within the Crazy and Silverfish PSUs and the KNF to support existing populations. In addition, mitigation associated with combined agencies' alternatives would increase the proportion of

designated old growth and promote the maintenance or development of flammulated owl habitat in the analysis area.

Cumulative noise and other human-caused disturbances could occur as a result of the combined action alternatives and other reasonably foreseeable actions. Cumulative disturbance effects could affect individual flammulated owls, but would not likely affect flammulated owl populations in the KNF.

3.24.4.6.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6); All alternatives would meet this KFP direction for the flammulated owl.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

All alternatives are consistent with KFP direction for snags, snag replacement trees, and down wood (KFP Vol. 1, II-1 #8 and II-7; Vol. 2, Appendix 16). See section 3.24.2, *Key Habitats*.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual flammulated owls and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability. This determination is based on: 1) the mine alternatives would have no impact on flammulated owls in the Silverfish PSU; 2) all combined action alternatives would result in the direct loss of flammulated owl habitat, but sufficient habitat would remain in the analysis area to support a large number of nesting pairs; 3) all action alternatives would result in an increase in habitat fragmentation, and a decrease in habitat effectiveness due to potential displacement; 4) no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a); 5) implementation of timing restrictions and pre-construction surveys included in the combined action alternatives would minimize potential impacts to nesting flammulated owls; 6) mitigation measures for the action alternatives and other actions, such as improvement harvest and prescribed burning, and habitat acquisitions and road access changes, would offset some of the impacts to flammulated owl habitat; 7) all combined mine-transmission line alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation that may provide flammulated owl habitat; and 8) sufficient habitat within the Crazy and Silverfish PSUs and across the KNF would remain to support existing populations.

3.24.4.7 Townsend's Big-Eared Bat

3.24.4.7.1 Analysis Area and Methods

Townsend's big-eared bat population ecology, biology, habitat description, and relationships identified by research are described in Reel *et al.* (1989); Perkins and Schommer (1991); Kunz and Martin (1982); MNHP (1993); Christy and West (1993); Ross (1967); Whitaker *et al.* (1977); Thomas and West (1991); and Pierson *et al.* (1999). That information is incorporated by reference. Townsend's big-eared bat occurrence data come from recent District wildlife survey records and KNF historical data (NRIS FAUNA) and the MNHP.

The analysis area for project impacts to individuals and their habitat in the KNF is the Crazy and Silverfish PSUs. The analysis area for evaluating direct and indirect impacts of the transmission line on Townsend's big-eared bat on private and state land consists of all non-National Forest System lands that would be disturbed by any of the transmission line alternatives. The KNF and any non-National Forest System lands potentially disturbed by the alternative transmission line alignments is the analysis area for cumulative effects.

The impacts analysis includes an evaluation of the potential benefits to Townsend's big-eared bat from mitigation measures proposed by MMC or the agencies, such as implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), land acquisition associated with grizzly bear mitigation, and the designation of additional old growth habitat.

3.24.4.7.2 Affected Environment

Townsend's big-eared bats are known to feed along forest edges, and can be associated with either dry or wet type coniferous forests. Tree cavities provide potential roosting habitat for the Townsend's big-eared bat (Perkins and Schommer 1991; MNHP 1993), and preference is shown for old growth forest (Thomas and West 1991). Caves and mines are used as winter hibernacula, day and night roosts, and maternity roosts, and are important habitat for this species (USDA Forest Service 2003b). Young and mature forests are used for feeding (ibid.), with primary foraging areas near lakes (Grindal 1995). A KNF status summary of the Townsend's big-eared bat was documented by Johnson (1999). During surveys of the KNF conducted from 1993 to 1995 by Hendricks *et al.* (1995, 1996), the species was located in all planning units, but no key roosting sites such as caves or mines have been located. The bat population size on the KNF is unknown.

Observations recorded prior to 1997 by the District, Forest, and MNHP have documented the Townsend's big-eared bat within the Crazy and Silverfish PSUs, specifically at Howard Lake and in the Libby Creek Recreational Gold Panning Area on Libby Creek (Westech 2005a). Abandoned mines potentially providing hibernacula are known to exist within the Crazy and Silverfish PSUs, and include the Gloria, Copper Reward, and Snowshoe mines (Hargrave *et al.* 1999).

Larger diameter snags or trees in the analysis area could be used for summer roosting. As discussed in section 3.21, *Vegetation*, the Crazy PSU contains 16.3 percent designated effective old growth, and 19.0 percent total old growth acres, including both designated and undesignated old growth. The Silverfish PSU contains 10.2 percent designated effective old growth, and 12.7 percent total old growth acres. These stands and the remaining timbered habitat provide suitable roosting habitat in the form of large snags with cavities, as well as abundant foraging habitat across the forest landscape. As described for snag habitat, snag levels are greater than KFP-

recommended levels. Existing conditions for cavity habitat are also described for the pileated woodpecker in section 3.24.3, *Management Indicator Species*.

3.24.4.7.3 Environmental Consequences

Alternative 1 – No Mine

There would be no expected change in the existing condition with implementation of Alternative 1. On National Forest System lands, no direct effect to cavity habitat potential would occur, and the PPI for pileated woodpecker, the MIS for cavity habitat, would remain at 12 for the Crazy PSU and 11 for the Silverfish PSU. Impacts to the pileated woodpecker are described in section 3.24.3, *Management Indicator Species*.

Alternative 2 – MMC's Proposed Mine

In Alternative 2, no impacts to potential Townsend's big-eared bat habitat would occur in the Silverfish PSU. Harvest of old growth habitat and losses of other coniferous habitat associated with Alternative 2 would reduce and fragment available day-roosting habitat for the Townsend's big-eared bat in the Crazy PSU. Impacts to coniferous forest, old growth, and cavity habitat are described in sections 3.21, *Vegetation* and 3.24.3, *Management Indicator Species*. In Alternative 2, the KNF standards for minimum 10 percent old growth and for snag habitat would be met for both PSUs and the KNF. The PPI for pileated woodpecker, the MIS for cavity habitat, would not change as a result of Alternative 2. Disturbance or mortality of bats could occur if bats were using a snag that was cut down during construction. The loss of snags providing potential Townsend's big-eared bat roosting habitat resulting from Alternative 2 would have minor impacts on this bat, given the existing snag levels (see section 3.24.2, *Key Habitats*). Noise and other disturbances, such as blasting, construction of the plant and adit sites, road construction and use, and plant and adit operations could cause Townsend's big-eared bats to avoid nearby habitat, at least temporarily. Disturbance impacts would likely be greatest during the construction phase, but could persist through mine operations. Losses and degradation of old growth providing potential bat habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if bat habitat were present on the acquired parcels. Alternative 2 would not affect caves, mines, tunnels, or lakes in either the Crazy or Silverfish PSU. Although some individual Townsend's big-eared bats could be impacted by Alternative 2, given the availability of surrounding habitat, the proposed project would not be expected to reduce local bat populations. At mine closure, MMC would evaluate the feasibility of developing bat habitat in the adits by recessing the adit plug.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to Townsend's big-eared bat from Alternative 3 would be the same as Alternative 2, except that impacts to potential Townsend's big-eared bat habitat would be minimized through implementation of mitigation measures. The Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize clearing and snag removal, and additional areas of old growth would be managed to retain or develop old growth characteristics. Also, the agencies' land acquisition program would likely be more effective at improving bat habitat because more land would be protected.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to Townsend's big-eared bat from Alternative 4 would be the same as Alternative 3.

Alternative A – No Transmission Line

On National Forest System lands, Alternative A would not physically affect cavity habitat or the PPI for Townsend's big-eared bat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

No direct impacts from Alternative B to old growth would occur in the Silverfish PSU. Harvest of old growth habitat associated with Alternative B would reduce available day-roosting habitat for Townsend's big-eared bat in the Crazy PSU. In Alternative B, the KNF standards for 10 percent old growth and for snag habitat would be met for both PSUs and the KNF. Alternative B would remove about 4 acres of old growth providing potential Townsend's big-eared bat habitat on private land along the Fisher River and a short portion of Miller Creek. Impacts to old growth is described in sections 3.21, *Vegetation* and 3.24.3, *Management Indicator Species*. Disturbance or mortality of bats could occur if bats were using a snag that was cut down during line construction. Clearing of old growth and snags would be minimized through implementation of the Environmental Specifications (Appendix D). Noise from helicopters during line stringing and from other construction-related activities could cause Townsend's big-eared bats to avoid nearby habitat, at least temporarily. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction. Alternative B would not affect caves, mines, tunnels, or lakes in either the Crazy or Silverfish PSU. Although some individual Townsend's big-eared bats could be impacted by Alternative B, given the availability of surrounding habitat, the proposed project would not be expected to reduce local Townsend's big-eared bat populations.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative C would be the same as Alternative B, except that impacts to potential Townsend's big-eared bat habitat also would be minimized through implementation of mitigation measures, such as the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), which would minimize clearing and snag removal, and designation of additional areas of old growth that would be managed to retain or develop old growth characteristics. Also, only 2 acres of old growth potentially providing bat habitat on private land would be impacted by Alternative C, as opposed to 4 acres for Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative D would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative E would be the same as Alternative C, except that more old growth potentially providing bat habitat on private land would be impacted by Alternative E than Alternative C. About 6 acres of old growth would be impacted by Alternative E, as opposed to 2 acres for Alternative C.

Combined Mine-Transmission Line Effects

In all combined mine-transmission line alternatives, no impacts to potential Townsend's big-eared bat habitat would occur in the Silverfish PSU. Harvest of old growth habitat and losses of other coniferous habitat resulting from the combined action alternatives would reduce and fragment available day-roosting habitat for the Townsend's big-eared bat in the Crazy PSU. In all combined

mine-transmission line alternatives, the KNF standards for minimum 10 percent old growth and for snag habitat would be met for both PSUs and the KNF. Impacts to coniferous forest, old growth is described in sections 3.21, *Vegetation* and 3.24.3, *Management Indicator Species*. Disturbance or mortality of bats could occur if bats were using a snag that was cut down during construction. The loss of snags providing potential Townsend's big-eared bat roosting habitat resulting from the combined action alternatives would have minor impacts on this bat, given the existing snag levels (see section 3.24.2, *Key Habitats*). None of the combined mine-transmission line alternatives would affect caves, mines, tunnels, or lakes in either the Crazy or Silverfish PSU.

In all combined action alternatives, noise from helicopters during line stringing and from other construction-related activities could cause Townsend's big-eared bats to avoid nearby habitat, at least temporarily. Disturbance impacts from blasting and helicopters would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning. Disturbance impacts during mine operations would probably be lower in intensity, but would last through the life of the mine.

Losses and degradation of old growth providing potential bat habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation in all combined action alternatives, if bat habitat were present on the acquired parcels, although the agencies' land acquisition program would likely be more effective at improving bat habitat than MMC's proposed program, because more land would be protected. All combined action alternatives would minimize the loss of old growth and snags in the transmission line clearing area through implementation of the Environmental Specifications (Appendix D). In all combined agencies' alternatives, impacts to potential Townsend's big-eared bat habitat also would be minimized through implementation of mitigation measures, such as the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) and the designation of additional areas of old growth that would be managed to retain or develop old growth characteristics (section 2.5.7.3.2, *Key Habitats*). At mine closure, MMC would evaluate the feasibility of developing bat habitat in the adits by recessing the adit plug.

Although some individual Townsend's big-eared bats could be impacted by the combined action alternatives, given the availability of surrounding habitat, the proposed project would not be expected to reduce local bat populations.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; and increases in tree density and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provide access to old growth habitat, contributing removal of snags important to Townsend's big-eared bats. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of bat habitat in the analysis area. Impacts to Townsend's big-eared bats on private and state lands would probably be minimal because it is likely that limited amounts of old growth occur on private and state lands, based on past and current harvest practices. Alternative 1A would not have cumulative impacts on the Townsend's big-eared bat or its habitat.

Regeneration harvest included in the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, would not directly affect old growth providing potential Townsend's big-eared bat habitat. While the combined action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of bat habitat, cumulative impacts on overall amounts of old growth would likely be minimal. In addition, mitigation associated with combined agencies' alternatives would increase the proportion of designated old growth and promote the maintenance or development of old growth providing Townsend's big-eared bat habitat in the analysis area.

Cumulative noise and other disturbances could occur as a result of the combined action alternatives and other reasonably foreseeable actions. Cumulative disturbance effects could affect individual Townsend's big-eared bats, but would not likely affect their populations in the KNF.

Cumulatively, the timber harvest activities on public and private lands and the removal of dead standing trees, as well as the removal of live trees with cavities (depending on their diameter) could reduce potential summer roosting sites for the Townsend's big-eared bat in other parts of the analysis area. No direct cumulative effects on key hibernacula would occur because no caves or mines are known to occur in either the Crazy or Silverfish PSU.

None of the action alternatives would change the existing PPI for the MIS for cavity-nesting species, and would not likely contribute to cumulative effects on Townsend's big-eared bats or their habitat. The existing snag levels are greater than KFP-recommended levels. Cumulatively, with all other reasonably foreseeable actions on private and corporate lands considered, sufficient cavity habitat would remain in the Crazy and Silverfish PSUs and the KNF to maintain existing Townsend's big-eared bat populations.

3.24.4.7.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this KFP direction for the Townsend's big-eared bat.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*. The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

All alternatives are consistent with KFP direction for snags, snag replacement trees, and downed wood (KFP Vol. 1, II-1 #8 and II-7; Vol. 2, Appendix 16). See section 3.24.2, *Key Habitats*.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable

populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual Townsend's big-eared bats and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability. This determination is based on: 1) none of the combined mine-transmission line alternatives would affect key hibernacula, because no caves or mines are known to occur in either the Crazy or Silverfish PSU; 2) timber harvest activities associated with the combined action alternatives would reduce potential summer roosting sites for the Townsend's big-eared bat, but impacts would be too small to change the existing PPI for pileated woodpecker, the MIS for cavity-nesting species; and 3) snag levels would continue to be greater than KFP-recommended levels and sufficient cavity habitat would remain in the Crazy and Silverfish PSUs and the KNF to maintain existing Townsend's big-eared bat populations; and 4) a forested environment suitable for foraging would remain well distributed across the Crazy and Silverfish PSUs and the KNF.

3.24.4.8 Western Toad

3.24.4.8.1 Analysis Area and Methods

Western toad ecology, biology, habitat use, status, and conservation are described and summarized in Maxell (2000) and Reichel and Flath (1995). That information is incorporated by reference. Western toad occurrence data come from District wildlife observation records and KNF historical data (NRIS FAUNA) and other agencies (MNHP).

Criteria used to compare the alternative impacts on the western toad and its habitat includes impacts to known breeding/rearing habitat, potential breeding habitat, and potential upland foraging habitat. In the analysis area, potential breeding habitat is represented by wetlands and aquatic habitat, as described in section 3.22, *Wetlands and Other Waters of the U.S.* Upland foraging habitat is represented in the KNF by habitat providing cover, as described for the deer and elk analyses, which includes riparian habitat not already included in breeding habitat. For private and state land, upland foraging habitat is represented by unharvested coniferous forest, as described in section 3.21, *Vegetation*. Although some harvested areas may provide upland foraging habitat, data were not available to evaluate habitat conditions in these areas at this level of detail. For this analysis, it was assumed that harvested areas do not provide potential habitat.

The analysis area for project impacts to individuals and their habitat in the KNF is the Crazy and Silverfish PSUs. The analysis area for evaluating direct and indirect impacts of the transmission line on western toads on private and state land consists of all non-National Forest System lands that would be disturbed by any of the transmission line alternatives. The KNF and any non-National Forest System lands potentially disturbed by the alternative transmission line alignments is the analysis area for cumulative effects.

The impacts analysis includes an evaluation of the potential benefits to western toads from mitigation measures proposed by MMC or the agencies, such as implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition)*, wetlands mitigation, fisheries mitigation, KNF riparian standards and guidelines, and water quality standards.

3.24.4.8.2 Affected Environment

Western toads require over-wintering, breeding/rearing, and foraging habitat, and may also be dependent on habitats suitable for migration if the three required habitat types are isolated spatially (Maxell 2000). Over-wintering may take place in underground caverns or in rodent

burrows, breeding/rearing takes place in aquatic sites such as shallow areas of large and small lakes or temporary ponds, and foraging habitat consists largely of terrestrial uplands (ibid.). In Montana, the species has been documented to occur as high as 9,220 feet in elevation.

Quantitative data regarding the western toad's use of upland and forested habitats is limited. Western toads are known to migrate between the aquatic breeding and terrestrial non-breeding habitats (NatureServe 2007). Movement of toads between breeding sites has been documented from 1.6 miles to greater than 3 miles (Corn *et al.* 1998; Bartelt and Peterson 1994). Movement in foraging areas may be influenced by the distribution of shrub cover, and toads may avoid habitats with low canopy closure and shrub cover, such as clearcuts (Bartelt and Peterson 1994). Down wood may be important in providing refugia for this species (ibid.).

According to the KNF status summary of the western toad (Johnson 1999), the species has been found in seven of the eight planning units in the KNF. The population size is unknown and direct measures of population trend on the KNF are not available (Johnson 1999). About 35 breeding sites were verified in the KNF between 1995 and 1998 (ibid.).

Results of annual District surveys have not identified any breeding sites in the Crazy or Silverfish PSUs (Johnson 1999). Observation from the late 1980s and early 1990s suggest that western toad breeding may be present in the Little Cherry Creek drainage (Westech 2005a). In August 2007, one adult western toad was found in the Poorman Tailings Impoundment Site in the Crazy PSU (Geomatrix 2007e). Potential breeding habitat is present in the Crazy and Silverfish PSUs in aquatic and wetland habitats, including temporal ponds or road ditches. Upland terrestrial habitat providing relatively good shrub or forest cover within the Crazy and Silverfish PSUs is considered potential foraging habitat. About 62,751 and 66,467 acres of upland terrestrial western toad habitat occur in the Crazy and Silverfish PSUs, respectively.

The majority of the non-National Forest System lands in the analysis area have high road densities and have been logged in the past 20 to 30 years, resulting in fragmented coniferous. Vegetation communities in the analysis area, including private and state land, are shown on Figure 83.

3.24.4.8.3 Environmental Consequences

Impacts to western toads from mine and transmission line alternatives are shown in Table 185 and Table 186 and are described in the following subsections.

Alternative 1 – No Mine

Alternative 1 would not affect the western toad.

Alternative 2 – MMC's Proposed Mine

Alternative 2 would result in an increased risk of incidental mortality of western toads. Alternative 2 would result in disturbance to about 37 acres of wetland habitat providing potential breeding habitat for the western toad (Table 185). All wetlands affected would be replaced with wetlands with similar functions and values. Impacts to wetlands are described in section 3.22, *Wetlands and Other Waters of the U.S.* This loss would be mitigated through implementation of MMC's Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*).

Table 185. Impacts to Western Toad Habitat in the Analysis Area by Mine Alternative.

Measurement Criteria	[1] No Mine	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment	[4] Agency Mitigated Little Cherry Creek Impoundment
Potential breeding habitat impacted[1] (acres)	0	37	14	37
Upland foraging habitat impacted[2] (acres)	0	2,197	1,811	1,895

[1] Potential breeding habitat is represented by wetlands and aquatic habitat as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[2] Habitat providing cover, as described for white-tailed deer and elk. Includes riparian habitat not already included in breeding habitat.
Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Table 186. Impacts to Western Toad Habitat in the Analysis Area by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek	[C] Modified North Miller Creek Transmission Line	[D] Miller Creek Transmission Line	[E] West Fisher Creek Transmission Line
Crazy and Silverfish PSUs					
Potential breeding habitat impacted[1] (acres)	0	10	3	13	12
Upland foraging habitat impacted[2] (acres)	0	189	175	178	243
Private and State Land					
Potential breeding habitat impacted[1] (acres)	0	9	2	2	17
Upland foraging habitat impacted[2] (acres)	0	18	67	73	58

[1] Potential breeding habitat in KNF is represented by wetlands and aquatic habitat as described in section 3.22, *Wetlands and Other Waters of the U.S.* Potential breeding habitat on private and state land is represented by wetland/riparian habitat as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[2] In KNF consists of habitat providing cover, as described for white-tailed deer and elk. Includes riparian habitat not already included in breeding habitat. For private and state land includes unharvested coniferous forest, as described in section 3.21, *Vegetation.*
Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

About 2,197 acres of upland foraging habitat would be disturbed by Alternative 2 (Table 185). Impacted habitat would represent about 4 percent of the total foraging habitat available. Some down wood and wintering habitat also would be lost as a result of Alternative 2. Relative to existing habitat and down wood, these losses would have minor impacts on the western toad.

The fragmentation of natural habitats from timber harvesting and road building may impede dispersal and decrease the probability of wetland recolonization by amphibians (Semlitsch 2000). Western toads are considered terrestrial habitat generalists (deMaynadier and Hunter 1998) and tend to be more tolerant than some amphibians of forest edges, tree harvests, and declining patch size (Renken *et al.* 2004).

A review of the available literature by Semlitsch (2000) indicates timber harvest and road construction activities can impact aquatic breeding habitat by altering the hydrological cycle of wetlands, which can impair completion of larval metamorphosis through early pond drying, or result in increased predation if ponds persist longer. Aquatic habitat quality can also be reduced as a result of increased sedimentation and water temperatures. In Alternative 2, indirect impacts to aquatic habitat from increased sedimentation would be minor, and would be minimized through implementation of erosion control BMPs. Increases in water temperature as a result of Alternative 2 are not anticipated. Mine inflows, discharges, and stream diversions projected for Alternative 2 may change lake levels and streamflows, potentially impacting western toad habitat. Impacts to water quantity and quality and aquatic habitat are described in sections 3.12, *Surface Water Quality* and 3.6, *Aquatic Life and Fisheries*.

Fisheries mitigation, especially habitat improvement in Libby Creek, and wetland mitigation, such as the creation of new wetlands, would offset some of the potential impacts of Alternative 2 on western toad breeding habitat. Impacts to aquatic habitat would be minimized through implementation of KNF riparian standards and guidelines, as amended by the INFS (USDA Forest Service 1995). Impacts to water quantity and quality and aquatic habitat are described in sections 3.12, *Surface Water Quality* and 3.6, *Aquatic Life and Fisheries*.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to western toad from Alternative 3 would be less than Alternative 2, affecting less wetland habitat (14 acres) and less upland foraging habitat (1,811) (Table 185). Also, implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (sections 2.4.6.1, *Wetland Mitigation Plan* and 2.5.3.2.1, *Vegetation Removal and Disposition*) also would minimize impacts to wetlands.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to western toad from Alternative 4 would be less than Alternative 2, affecting less upland foraging habitat (1,895 acres) (Table 185).

Alternative A – No Transmission Line

Table 186 summarizes the impacts to western toad habitat due to each alternative. Alternative A would not affect the western toad.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The clearing area for Alternative B would include about 10 acres of western toad breeding habitat in the Crazy and Silverfish PSUs and 9 acres of western toad breeding habitat on private land

(Table 186). Impacts to wetlands are described in section 3.22, *Wetlands and Other Waters of the U.S.*

About 189 acres of upland foraging habitat in the Crazy and Silverfish PSUs and 18 acres of upland foraging habitat on private land would be disturbed by Alternative B (Table 186), which represents less than 1 percent of the total foraging habitat available. Some down wood and wintering habitat also would be lost as a result of Alternative B. Relative to existing habitat and availability of down wood, these losses would have minor impacts on the western toad.

Alternative B includes the construction of about 10 miles of new access roads; sedimentation from new road construction would be minimized through implementation of erosion control BMPs.

The fragmentation of natural habitats from timber harvesting and road building may impede dispersal and decrease the probability of wetland recolonization by amphibians (Semlitsch 2000). Alternative B includes the construction of about 10 miles of new access roads, which would contribute to fragmentation of western toad upland foraging habitat. Western toads are considered terrestrial habitat generalists (deMaynadier and Hunter 1998), and tend to be more tolerant than some other amphibians of forest edges, tree harvests, and declining patch size (Renken *et al.* 2004).

Impacts to western toad breeding habitat would be minimized through implementation of MMC's Wetland Mitigation Plan (section 2.4.6.1, *Wetland Mitigation Plan*), and the Environmental Specifications (Appendix D).

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to the western toad from Alternative C would be less than Alternative B, affecting less breeding habitat. The clearing area for Alternative C would include about 3 acres of breeding habitat in the Crazy and Silverfish PSUs and 2 acres of breeding habitat on private land providing potential breeding habitat. Slightly less upland foraging habitat would be disturbed by Alternative C than Alternative B in the Crazy and Silverfish PSUs (178 acres instead of 189 acres), while more upland foraging habitat would be impacted on private land (67 acres instead of 18 acres) (Table 186). Also, fewer miles of new access roads would be constructed for Alternative C than Alternative B (3 miles instead of 10 miles), and the potential for stream sedimentation would be lower. Implementation of the agencies' Wetland Mitigation Plan and the Vegetation Removal and Disposition Plan (sections 2.4.6.1, *Wetland Mitigation Plan* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D) also would minimize impacts to western toad breeding habitat.

Alternative D – Miller Creek Transmission Line Alternative

Alternative D would disturb more western toad breeding habitat in the Crazy and Silverfish PSUs than Alternative B. The clearing area for Alternative D would include about 13 acres of breeding habitat in the Crazy and Silverfish PSUs. Slightly more upland foraging habitat would be disturbed by Alternative D than Alternative B (178 acres instead of 175 acres in the Crazy and Silverfish PSUs, and 73 acres instead of 67 acres on private land) (Table 186). Also, fewer miles of new access roads would be constructed for Alternative D than Alternative B (3 miles instead of 10 miles), and the potential for stream sedimentation would be lower.

Alternative E – West Fisher Creek Transmission Line Alternative

Impacts to the western toad from Alternative E would be the same as Alternative D, except that 1 more mile of new access roads would be constructed and more upland habitat would be impacted in the Crazy and Silverfish PSUs (243 acres instead of 178 acres). Alternative E would impact more western toad habitat on private and state land than Alternative D, including 17 acres of western toad breeding habitat and 58 acres of upland foraging habitat. The potential for stream sedimentation would be essentially the same for Alternatives D and E.

Combined Mine-Transmission Line Effects

Impacts to western toad habitat for combined mine-transmission line alternatives are displayed in Table 187 and described below.

Table 187. Impacts to Western Toad Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy and Silverfish PSUs								
Potential breeding habitat impacted[1] (acres)	0	32	15	24	24	29	38	38
Upland foraging habitat impacted[2] (acres)	0	2,386	1,986	1,989	2,054	2,070	2,073	2,138
Private and State Land								
Potential breeding habitat impacted[1] (acres)	0	9	2	2	17	2	2	17
Upland foraging habitat impacted[2] (acres)	0	18	67	73	58	67	73	58

[1] Potential breeding habitat in KNF is represented by wetlands and aquatic habitat as described in section 3.22, *Wetlands and Other Waters of the U.S.* Potential breeding habitat on private and state land is represented by wetland/riparian habitat as described in section 3.22, *Wetlands and Other Waters of the U.S.*
[2] In KNF consists of habitat providing cover, as described for white-tailed deer and elk. Includes riparian habitat not already included in breeding habitat. Private and state land includes unharvested coniferous forest, as described in section 3.21, *Vegetation*.
Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Alternatives 4D and 4E would affect the most western toad breeding habitat in the Crazy and Silverfish PSUs, resulting in impacts to 38 acres. Alternatives 3D and 4D would affect the most western toad breeding habitat on state and private land, affecting 17 acres (Table 187). Alternative 3C would have the least impact on western toad breeding habitat, affecting 15 acres in the Crazy and Silverfish PSUs and 2 acres on private and state land. Upland foraging habitat in the Crazy and Silverfish PSUs would be affected the most by Alternative 2B, impacting 2,386 acres.

Alternatives 3D and 4D would affect the most upland foraging habitat on state and private land, impacting about 73 acres. In all combined action alternatives, implementation of Wetland Mitigation Plans (section 2.4.6.1, *Wetland Mitigation Plan*) and the Environmental Specifications (Appendix D) would minimize impacts to western toad breeding habitat. The agencies' alternatives also would minimize impacts through implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*).

The fragmentation of natural habitats from timber harvesting and road building may impede dispersal and decrease the probability of wetland recolonization by amphibians (Semlitsch 2000). Alternative 2B would include the most new road construction (about 11.7 miles). New road construction for the combined agencies' alternatives would be comparable, ranging from 4.7 miles for Alternatives 3C, 3D, 4C, and 4D to 5.7 miles for Alternatives 3D and 3E. Western toads are considered terrestrial habitat generalists (deMaynadier and Hunter 1998), and tend to be more tolerant than some amphibians of forest edges, tree harvests, and declining patch size (Renken *et al.* 2004). New road construction, while it may affect individual western toads, would not affect the western toad population in the analysis area.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; increases in tree density; and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Continuing development of private lands, including timber harvest, home construction, and land clearing, would contribute to losses of western toad habitat in the analysis area.

Timber harvest and other clearing activities planned for the Miller-West Fisher Vegetation Management Project would contribute to cumulative losses of upland foraging habitat for western toads in the Silverfish PSU. The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. In the short term, slash and/or burn units would not provide habitat until shrub cover returned (2 to 3 years). Other reasonably foreseeable actions would involve minimal surface disturbance.

Alternative 1A would not contribute to cumulative losses of western toad habitat. While the combined action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of western toad habitat in the analysis area, sufficient habitat would remain within the Crazy and Silverfish PSUs and the KNF to support existing populations.

Road construction and improvements would occur for other reasonably foreseeable actions, including the Miller-West Fisher Vegetation Management Project, several mine and private property access projects, and forest road maintenance and improvement. The construction of new roads and the improvement of existing roads associated with the combined action alternatives, in combination with other reasonably foreseeable actions, could result in an increased risk of incidental mortality of western toads due to increased traffic volumes; fragmentation of upland habitat; to a lesser degree, breeding habitat; and increased sedimentation and decreased quality of aquatic habitat in the analysis area. For the mine alternatives, mine inflows, discharges, and stream diversions associated with the mine alternatives and other reasonably foreseeable mines,

in particular the Rock Creek Project, could result in cumulative changes in lake levels, spring flows, and streamflows, potentially impacting western toad breeding habitat. Cumulative impacts to water quantity and quality and aquatic habitat are described in sections 3.12, *Surface Water Quality* and 3.6, *Aquatic Life and Fisheries*.

Mitigation associated with the action alternatives and other reasonably foreseeable actions would offset some of the potential cumulative impacts to the western toad. Mitigation measures would include wetlands creation, habitat improvement in Libby Creek, road access changes, and habitat acquisitions.

3.24.4.8.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6); All alternatives would meet this KFP direction for the western toad. All alternatives are consistent with KFP riparian standards and guidelines (KFP Vol. 1, II-28 thru 33) as amended by INFS.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual western toads and their habitat, but would not contribute to a trend toward federal listing or loss of species viability. This determination is based on: 1) the combined action alternatives would affect between 17 and 45 acres of potential western toad breeding habitat (wetlands); 2) in all combined action alternatives, implementation of Wetland Mitigation Plan (section 2.4.6.1, *Wetland Mitigation Plan*) and the Environmental Specifications (Appendix D) would minimize impacts to western toad breeding habitat; the agencies' alternatives also would minimize impacts through implementation of the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*); 3) the combined action alternatives would affect between 2,053 and 2,404 acres of upland foraging habitat; 4) all combined action alternatives would result in an increase in habitat fragmentation and increased mortality risk due to higher traffic volumes; and 5) sufficient large downed wood habitat would remain to provide refugia, and sufficient cover would remain in the Crazy and Silverfish PSUs and the KNF to maintain existing western toad populations.

3.24.4.9 Wolverine

3.24.4.9.1 Analysis Area and Methods

Wolverine population ecology, biology, habitat description, and relationships identified by research are described in Banci (1994) and Butts (1992). That information is incorporated by reference. Wolverine occurrence data come from recent District wildlife observation records, KNF historical data (NRIS FAUNA), and FWP. Wolverines are habitat generalists for all activities except for denning; the impacts analysis was based on denning habitat only. Potential wolverine denning habitat was estimated based on KNF CEM and TSMRS vegetation data and the KNF CEM wolverine denning habitat model (see KNF project record).

Wolverines are sensitive to human disturbance (Butts 1992; Thomas 1995; Copeland 1996; Weaver *et al.* 1996; Witmer *et al.* 1998; Joslin and Youmans 1999). Distances that wildlife species are displaced due to human activity vary, but in general, impacts for most species may occur up to 0.33 mile or the nearest ridgeline from the source of disturbance (Christensen and Madel 1982; Schirato 1989; Frederick 1991; Grant *et al.* 1998; Austin 1998), and may extend up to 1 mile, depending on type of disturbance (Bury 1983; USDA Forest Service 1988a; IGBC 1990). In absence of species-specific data, the influence zones suggested for grizzly bear in the grizzly bear Cumulative Effects Model (USDA Forest Service 1988a) were used to estimate the displacement effects of disturbances associated with mine construction and operations on wolverines. Wolverines are most sensitive to human disturbance during the denning period (December 1 to April 30) (Copeland 1996).

The analysis area for direct, indirect, and cumulative project impacts to individuals and their habitat and consists of the Crazy and Silverfish PSUs. Wolverine habitat does not occur on private land within the zone of influence of the proposed project.

The impacts analysis includes an evaluation of the potential benefits to wolverines from mitigation measures proposed by MMC or the agencies, such as habitat acquisitions and access changes planned as mitigation for the impacts to grizzly bear and big game security, and prohibiting employees from carrying firearms.

3.24.4.9.2 Affected Environment

The wolverine is a very secretive animal generally associated with remote areas (Hash 1987). Wolverines usually occupy higher elevations in summer and lower elevations in winter in northwestern Montana (MNHP 2008). The wolverine usually requires large tracts of wilderness and is sensitive to habitat fragmentation (Banci 1994). Wolverines are primarily scavengers and generally do not hunt for their own food. While wolverines appear to be relative generalists in selection of habitat for most activities, female wolverines are more selective in their choice of natal denning sites, preferring high elevation, snowy cirque basins, where they could dig through deep snow for protective cover for their young. Female wolverines are very sensitive to disturbance during the denning period. Denning habitat is widely available at the highest elevations on the KNF, but not common except in certain areas, such as the CMW.

Ruediger (1994) shows the KNF as a primary habitat area for wolverine. Johnson (1999) shows wolverine presence confirmed in seven of the eight planning units on the KNF. Wolverines and their signs have been recently documented in the Crazy and Silverfish PSUs. A wolverine was photographed in the upper Libby Creek drainage in 2006, and another videotaped in the Ramsey Creek drainage in 2007 (Brown, pers. comm. 2008; Williams, pers. comm. 2008). Wolverine tracks were documented in the upper Bear Creek drainage in 1995 and 2001 during winter track surveys conducted by FWP of the Snowshoe, Leigh, Big Cherry, Bear, and Poorman creek drainages (see KNF project record). In the Silverfish PSU, there have been 18 track observations and two visual sightings of wolverines from 1984 to present (one in the Porcupine Creek drainage and one in the Baree Creek drainage). Eleven sets of wolverine tracks and one potential den site have been documented along the Baree Lake Trail during annual or biannual surveys conducted by the Forest Service since 1989 (ibid.).

Based on habitat modeling, 4,118 acres of denning habitat occur in the Crazy PSU and 2,374 acres of denning habitat occur in the Silverfish PSU. Following the identification process outlined in Ruediger (1994), the Kootenai and Fisher PSUs are designated as secondary wolverine

conservation areas (Johnson 2004b). The Crazy and Silverfish PSUs are within a high-quality wolverine habitat area (ibid.). About 46,439 acres of potential wolverine denning habitat occur on the KNF (Johnson 1999).

3.24.4.9.3 Environmental Consequences

Of all mine and transmission line alternatives, only Alternative E would result in physical disturbance of wolverine denning habitat, impacting 2 acres. Impacts on wolverines from human activities associated with the transmission line alternatives and combined mine-transmission line alternatives are shown in Table 188 and Table 189 and described in the following subsections. The analysis of the effects of human activity on wolverines is based on activity-specific buffers, and includes the effects of open roads. Road access changes associated with mitigation were determined for combined mine-transmission line alternatives. It is not possible to attribute these road access changes to individual mine and transmission line alternatives independent of one another. Because the disturbance buffer applied to new or opened roads associated with the transmission line is encompassed entirely by the buffer applied to helicopter disturbance, effects of human activity during transmission line construction are calculated based on the area of overlap between the helicopter disturbance buffer and wolverine denning habitat. It is assumed that human disturbance would not affect wolverines during transmission line operations. The evaluation of the effects of human activity on wolverines from individual mine alternatives may be inferred from impact calculations for the combined mine-transmission line alternatives shown in Table 189.

Alternative A – No Transmission Line

Alternative A would have no effect on wolverine habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have no physical impacts on wolverine denning habitat. During the construction phase of Alternative B, habitat affected by human disturbance would increase by about 120 acres in the analysis area, mostly in the Ramsey Creek area due to line stringing conducted by helicopters (Table 188). Disturbance effects from helicopter line stringing would be short-term (10 days) and would be greatest if they occurred during the wolverine denning period. Disturbance effects could also occur from other transmission line construction activities in areas where helicopters were not used. Except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of wolverines during line decommissioning.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would have no physical impacts on wolverine denning habitat. During the construction phase of Alternative C, habitat affected by human disturbance would increase by about 10 acres in the analysis area, mostly due to line stringing conducted by helicopters at the mouth of the Libby Creek drainage (Table 188). In Alternative C, helicopters would be used in some segments for vegetation clearing and structure placement, as well as stringing the entire line, extending the duration of disturbance by about 2 months. Disturbance effects from helicopter use and other construction activities would be greatest if they occurred during the wolverine denning period. In Alternative C, except for annual inspection and infrequent

Table 188. Human Disturbance Effects on Wolverine in the Analysis Area by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)		[C] Modified North Miller Creek Transmission Line Alternative		[D] Miller Creek Transmission Line Alternative		[E] West Fisher Creek Transmission Line Alternative	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Habitat Affected by Human Activity in Analysis Area[3, 4] (acres)	136	256 (120)	136 (0)	146 (10)	136 (0)	146 (10)	136 (0)	146 (10)	136 (0)

Number shown in parentheses is the increase (in acres) compared to existing conditions.
[1] Const = during transmission line construction.
[2] Ops = during mine operations.
[3] Acres affected by human activity do not include areas of overlap from different sources of disturbance. Human disturbance was calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter construction = 1 mile on each side of disturbance.
[4] For Alternative B, the use of helicopters during line construction would be at the discretion of MMC. For this analysis, it is assumed that helicopters would not be used during construction or structure placement for Alternative B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 189. Human Disturbance Effects on Wolverine in the Analysis Area by Combined Mine-Transmission Line Alternative.

Habitat Component	[1] No Mine Existing Condition	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
	TL-A	TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Indirect Disturbance in Analysis Area[3,4] (acres)	136	1,015 (+879)	376 (+240)	922 (+786)	374 (+238)	922 (+786)	374 (+238)	922 (+786)	374 (+238)	922 (+786)	374 (+238)	922 (+786)	374 (+238)	922 (+786)	374 (+238)

Number shown in parentheses is the increase (in acres) compared to existing conditions.
[1] Const = during project construction.
[2] Ops = during project operations.
[3] Acres affected by human activity do not include areas of overlap from different sources of disturbance. Human disturbance effects were calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter construction = 1 mile on each side of disturbance.
[4] For Alternative 2B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used during vegetation clearing or structure placement for Alternative 2B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data.

maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Impacts to the wolverine from Alternative D would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Alternative E would physically impact about 2 acres of wolverine denning habitat. Human disturbance impacts from Alternative E would be the same as Alternative C.

Combined Mine-Transmission Line Effects

The effects of the combined mine-transmission line alternatives on wolverine are shown in Table 189 and summarized below.

Of the combined mine-transmission line alternatives, only Alternatives 3E and 4E would physically impact wolverine denning habitat, resulting in the physical disturbance of 2 acres. As a result of Ramsey Plant site activities, disturbance to wolverines from human activity during the construction phase would be the greatest in Alternative 2B, resulting in human disturbance impacts to 1,015 acres (Table 189). Combined agencies' alternatives could disturb 922 acres of wolverine denning habitat during the construction phase. Disturbance during construction would include surface blasting associated with construction of the adits and helicopter use during line stringing and would be short-term. Disturbance from helicopter use and other transmission line construction activities are described above for Alternatives B and C.

Blasting would likely be mostly underground at the Libby Adit, where a maximum of two rounds of blasting would occur at the surface. The Ramsey Adits would probably require a maximum of two rounds of surface blasting per adit. The ventilation raise would be constructed from inside the mine and would not require any surface blasting, except for creation of the surface opening. Construction of the Ramsey Adits for Alternative 2B and the lower and upper Libby Adits for the combined agencies' alternatives is expected to take about 1 year. The construction phase for all combined action alternatives is expected to last 2 to 3 years. During operations, human disturbance impacts would be essentially the same in all combined action alternatives, affecting between 374 and 376 acres. For all combined action alternatives, some disturbance effects would be offset by access changes (installation of gates or barriers and public access restrictions) and habitat acquisitions planned as mitigation for the impacts to grizzly bear and big game security. The combined agencies' alternatives would include more road access changes and more habitat acquisition, and would more effectively mitigate potential effects of disturbance to wolverines. In all combined action alternatives, the risk of wolverine mortality would increase as a result of increased access to wolverine habitat. All combined action alternatives would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, providing trappers easy winter access to wolverine habitat. Given the extent of human disturbance relative to surrounding habitat, impacts on wolverines from the combined action alternatives would be minor. Although some individual wolverines could be displaced from suitable habitat as a result of the combined action alternatives, impacts on the wolverine population in the analysis area would be minimal due to the extent of available habitat.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the old growth ecosystems in the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; increases in tree density; and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of wolverine habitat in the analysis area. Impacts to wolverine on private and state lands would probably be minimal because it is likely that wolverine habitat in these areas is of marginal quality.

Alternative 1A would not have cumulative impacts on the wolverine. Surface impacts from other reasonably foreseeable actions and the combined action alternatives in the analysis area would be minimal. Mineral exploration has occurred and would continue to occur throughout the Cabinet Mountains, cumulatively displacing wolverines from suitable habitat or reducing their ability to effectively use the available habitat. Human disturbance impacts to wolverines from the combined action alternatives would be compounded when impacts from other reasonably foreseeable actions, particularly the Wayup Mine/Fourth of July Road Access Project and the Bear Lakes Access Project are taken into account. Human disturbance effects would be greatest for activities that occur during the denning period (December 1 to April 30).

Some of the disturbance associated with construction of the proposed project and other reasonably foreseeable actions, such as blasting and helicopter line stringing and construction, would be short-term. Noise generated by construction and blasting for the evaluation adits for the Rock Creek Project would occur sporadically for several weeks. Underground blasting would be considered after the adit reaches a depth of about 500 feet at the Rock Creek site, based on experience at the Troy Mine adit. If blasting and other construction activities occurred concurrently for the Rock Creek and Montanore projects, cumulative noise disturbance could result in habitat displacement and increased stress levels for wolverines.

Other cumulative effects from the combined action alternatives include an increased risk of wolverine mortality from trapping due to increased access into wolverine denning habitat. Cumulative impacts could be offset by habitat acquisitions and road access changes associated with grizzly bear mitigation for the Montanore Project and other reasonably foreseeable actions. Some cumulative displacement effects would be offset by access changes planned as mitigation for the Montanore, Wayup Mine/Fourth of July Road Access, and the Bear Lakes Access projects.

3.24.4.9.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6). All alternatives would meet this KFP direction for the wolverine.

National Forest Management Act

KFP direction is to “maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations” (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual

wolverines and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability for the fisher. This determination is based on: 1) of the action alternatives, only Alternative E would have physical impacts to wolverine denning habitat, which would be negligible (2 acres); 2) transmission line and human disturbance effects would be minimal and largely short-term; 3) impacts of blasting for the mine alternatives would be short-term; and 4) long-term human disturbance effects during project operations would occur on a relatively small proportion of total denning habitat in the analysis area.

3.24.4.10 Irreversible and Irretrievable Commitments

No other irreversible commitment of resources related to Forest sensitive species would occur for any of the alternatives.

All of the combined action alternatives would result in physical impacts to wetlands, riparian, old growth, general forest, and snag habitat important to forest sensitive species. Disturbance to sensitive species due to human disturbance, disruption of movement patterns, and habitat fragmentation could also occur as a result of the combined action alternatives. These impacts would be long-term and would be an irretrievable commitment of resources.

3.24.4.11 Short-term Uses and Long-term Productivity

The transmission line alternatives would result in short-term direct impacts to habitat important to sensitive species in areas where there would be limited vegetation clearing due to topography, span length, and other factors. All of the action alternatives would result in long-term physical impacts to sensitive species habitat and long-term impacts due to human disturbance, disruption of movement patterns, and habitat fragmentation. If reclamation were successful and successional processes were allowed to take place, areas of disturbed habitat could potentially be restored to suitable sensitive species habitat after a considerable length of time. As described in section 3.21, *Vegetation*, the action alternatives would result in long-term losses of habitat for old growth-dependent sensitive species in the Crazy PSU.

3.24.4.12 Unavoidable Adverse Environmental Effects

All action alternatives would result in unavoidable long-term losses or degradation of sensitive species habitat and disturbance of individuals. With implementation of water quality standards, Wetland Mitigation Plans (sections 2.4.6.1, *Wetland Mitigation Plan* for Alternative 2 and section 2.5.7.1, *Wetland Mitigation* for Alternatives 3 and 4)and the Environmental Specifications (Appendix D), Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and mitigation measures such as compensatory wetlands creation, road access changes, and habitat acquisition, these effects would be minimized.

3.24.5 Threatened, Endangered, and Proposed Species

3.24.5.1 Regulatory Framework

Section 3.6, *Aquatic Life and Fisheries* discusses the regulatory framework for federally listed threatened or endangered species. The MFSA directs the DEQ to approve a transmission line if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives. An assessment of effects on federally listed threatened and endangered species is part of the transmission line certification process.

A current species list for the KNF was obtained from the USFWS website on June 6, 2008 (http://montanafieldoffice.fws.gov). The USFWS concurred with potential listed species distribution maps and resulting consultation areas for the KNF in 2001 (USFWS 2001). The status of federally listed threatened, endangered, and candidate wildlife species in the influence area of the proposed Montanore Project is shown in Table 190.

Table 190. Federally Listed Threatened, Endangered, and Candidate Species Potentially Affected by the Montanore Project.

Species	ESA Status	Status in Analysis Area	Comments*
Gray Wolf (*Canis lupus)*	Threatened	Known to occur	Inside Recovery Zone
Grizzly Bear (*Ursus arctos*)	Threatened	Known to occur	Inside Recovery Zone
Canada Lynx (*Lynx canadensis*)	Threatened	Known to occur	Inside Recovery Zone

*USFWS analysis area is inside Recovery Zone or reoccurring use area.

The USFWS removed the gray wolf from the list of threatened and endangered species on March 28, 2008. On July 18, 2008, the U.S. District Court for the District of Montana Missoula Division reinstated ESA protections for the northern Rocky Mountain gray wolf.

3.24.5.2 Gray Wolf

3.24.5.2.1 Analysis Area and Methods

Strategies to protect and recover wolf populations in Montana are outlined in the Northern Rocky Mountain Wolf Recovery Plan (USFWS 1987). The Montana Gray Wolf Conservation and Management Plan Final EIS (FWP 2003) specifies strategies to protect and manage wolf populations in Montana once they are recovered. The Northern Rocky Mountain Wolf Recovery Plan and the Montana Gray Wolf Conservation and Management Plan also provide descriptions of wolf ecology, biology, and habitat (USFWS 1987; FWP 2003). The KNF is within the Northwest Montana Recovery Area, one of three wolf recovery areas identified for the Northern Rocky Mountain wolf population (USFWS *et al.* 2004). Information for this recovery area is provided by the Rocky Mountain Wolf Recovery 2007 Annual Report (USFWS *et al.* 2008) and is incorporated herein by reference. Wolf occurrence data come from recent District wildlife observation records, forest historical data (NRIS FAUNA), other agencies (USFWS, FWP), and Wolf and Wildlife Studies, a private organization.

The analysis area for direct, indirect, and cumulative impacts to wolves and their habitat in the KNF are the Crazy and Silverfish PSUs. To evaluate potential direct, indirect, and cumulative impacts of the transmission line on gray wolves, the analysis area also includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The impacts analysis includes an evaluation of the potential benefits to wolves from mitigation measures. Mitigation measures incorporated into MMC's or the agencies' alternatives include access changes, land acquisition, prohibiting employees from carrying firearms, removing road-killed big game animals, busing employees to the work site, and monitoring road-killed animals along mine access roads to determine if improved access resulted in increased wildlife mortality, and the funding of two grizzly bear specialists and one law enforcement position.

Measurement indicators for evaluating effects of the alternatives on the gray wolf are based on the following key habitat components described in the Wolf Recovery Plan (USFWS 1987): year-round prey base, suitable denning and rendezvous sites, and sufficient space with minimal exposure to humans. The rationale for basing the impacts evaluation on these components and the indicators of effects are described in the following paragraphs.

Sufficient, Year-Round Prey Base

The condition of the prey base for the gray wolf is evaluated based on KFP management standards and objectives for white-tailed deer and elk. Effects of the alternatives on white-tailed deer and elk are described in section 3.24.3, *Management Indicator Species*.

Suitable Denning and Rendezvous Sites

Gray wolf den sites are generally greater than 1 mile from open roads and 1 to 2 miles from campsites (USFWS 1987). 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. Sensitivity to disturbance at den sites and subsequent abandonment varies greatly among individual wolves (Thiel *et al.* 1998; Claar *et al.* 1999). Rendezvous sites (resting and gathering areas) are usually complexes of meadows and adjacent timber, with surface water nearby (USFWS 1987). They tend to be situated away from human activity and on drier sites that are slightly elevated above riparian areas (ibid.). FWP encourages land management agencies to consider the locations of wolf den and rendezvous sites in their planning activities to maintain the habitat integrity of these sites (Sime 2002). Den and rendezvous sites can also be protected by enacting timing restrictions on proposed activities within the den/rendezvous site areas. These restrictions would limit operating periods to the fall or winter seasons when these sites are unoccupied.

Sufficient Space with Minimal Exposure to Humans

Providing sufficient space with minimal exposure to humans can reduce the risk of human-caused mortality to wolves. Human disturbance and accessibility of wolf habitats (*i.e.*, road densities) are the principal factors limiting wolf recovery in most areas (Leirfallom 1970; USFWS 1978, 1987 all in Frederick 1991; Thiel 1978). These components can be generally measured by maintaining ORD standards required by the KFP as well as maintaining any security habitat recommended in the big game habitat recommendations.

MMC's proposed Alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the yearlong access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include yearlong access changes, through the installation of barriers or gates, for several roads to mitigate for the loss of big game security and impacts to grizzly bear. Additional road access changes also would occur on land acquired as part of the mitigation plans proposed by MMC and the agencies. These road access changes would reduce potential exposure of wolves to humans.

3.24.5.2.2 Affected Environment

Distribution

At the end of 2007, there were 73 wolf packs in Montana, with 39 meeting breeding pair criteria. These packs contained a minimum estimate of 422 wolves (USFWS *et al.* 2008). The Montana

portion of the Northwest Recovery Area supported 31 of those packs (11 were breeding packs), consisting of 167 wolves. This area includes the KNF. There are currently 10 packs (5 breeding packs) using the KNF in all or part of their territories. These packs had 44 wolves at the end of 2007 (ibid.). There was one known mortality in the KNF packs in 2007.

The Fishtrap pack is the only known wolf pack potentially affected by the Montanore Project. The Fishtrap pack territory is located in and around the Thompson River, McGinnes Creek, and Fishtrap Creek drainages (USFWS *et al.* 2008), and includes portions of the Silverfish and McElk PSUs in an area in the southeast corner of the Libby Ranger District territory (McGinnis Meadows and East Fisher Creek). Since the pack was first documented in 2000, there have been five known depredations on livestock attributed to this pack, and three known wolf mortalities, including natural and human-caused mortalities (USFWS *et al.* 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008). No known mortalities occurred in the Fishtrap pack in 2007. Currently, the pack includes seven wolves and produced at least three pups in 2007. Three pack members are radio-collared. One radio-collared female wolf has left the Fishtrap pack and has joined the Mineral Mountain pack northwest of St. Regis (USFWS *et al.* 2008).

Seasonal movements of the Fishtrap pack vary from year-to-year. During the fall of 2002 and winter of 2003, the Swamp Creek corridor was used by the Fishtrap pack to travel across the Cabinet Mountains. Since that time, wolves have not been observed using this travel corridor (Laudon, pers. comm. 2008). In 2005 and 2006, the Fishtrap pack activity shifted to the southeast, perhaps in response to a new pack that appears to be using the Silver Butte Fisher River area (Mallonnee, pers. comm. 2006).

Tracks and other signs of one to two individual wolves have been consistently observed in the Libby, Midas, Poorman, Ramsey, Bear, and Big Cherry creek drainages since 2004. Wolf sign has also been observed in the West Fisher Creek, Miller Creek, and Swamp Creek drainages, and west of Howard Lake and north of Horse Mountain. In 2004, howls of 4 to 5 individual wolves were heard near Midas Point by two FWP biologists camped at Howard Lake. These observations suggest that at least two wolves use portions of the analysis area on a regular basis. No wolf packs or den sites have been confirmed in this general area (Laudon, pers. comm. 2008).

Prey Base

Abundant winter range and summer range used primarily by white-tailed deer, moose, and elk occurs in the analysis area. Populations of these three species combined provide a good year-round prey base for wolves. Existing habitat conditions for these species are described in section 3.24.3, *Management Indicator Species*.

Den and Rendezvous Sites

Wolf den and rendezvous sites are monitored annually. There are no known established den sites or rendezvous sites within either the Silverfish or Crazy PSU. At least one known den site and three documented rendezvous sites are located near McGinnis Meadows, about 6 miles south of U.S. 2 as it turns eastward toward Kalispell.

Sufficient Space with Minimal Exposure to Humans

The western half of the Crazy and Silverfish PSUs is dominated by the CMW and Inventoried Roadless Area (IRAs), which provide habitat for wolves and their prey base where exposure to humans is minimal. Most of the Crazy PSU is within Bear Management Unit (BMU) 5, which currently meets grizzly bear standards and objectives for core habitat, habitat effectiveness, and

linear ORD. Meeting grizzly bear standards also helps provide sufficient space for wolves with reduced exposure to humans. Most of the Silverfish PSU occurs within BMU 6, where grizzly bear standards and objectives for core habitat and habitat effectiveness are not met, but where linear ORD standards are met. No human-caused wolf mortalities have been documented for the Crazy or Silverfish PSU.

Private and State Land

Private and state land in the analysis area provides habitat for wolf prey species such as deer and elk, but this land has more roads that could provide human access to potential wolf habitat than National Forest System lands. Although private lands in the analysis area may receive some use by transient wolves, only the periphery of the Fishtrap pack territory extends to the extreme southern portion of private land in the analysis area.

3.24.5.2.3 Environmental Consequences

Alternative 1 – No Mine

Alternative 1 would not affect the gray wolf and would not change existing conditions for prey base, denning and rendezvous sites, or space with minimal exposure to humans.

Alternative 2 – MMC's Proposed Mine

None of the developments or activities associated with Alternative 2 would occur in the Silverfish PSU; Alternative 2 would not impact the gray wolf in the Silverfish PSU.

Prey Base

In Alternative 2, current populations of white-tailed deer, the MIS for general forest species in the Crazy PSU, would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions for these species are described in section 3.24.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known den or rendezvous sites would be affected by Alternative 2.

Sufficient Space with Minimal Exposure to Humans

Alternative 2 would increase linear road density in the Crazy PSU, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality. Linear ORD resulting from Alternative 2 construction would increase, and would be worse than the KFP standard. Alternative 2 would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, allowing poachers easy winter access to potential wolf habitat. Increased traffic could result in more wolves being killed by vehicles, although traffic increases are anticipated to be minimal (see section 3.20, *Transportation*). The Fishtrap pack does not occupy this area and would not likely be affected by Alternative 2. High road densities, increased human access, and disturbance from mine activities could impact other wolves using the Crazy PSU. Impacts to wolf habitat would be at least somewhat reduced through MMC's proposed land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be gated or barriered.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

None of the developments or activities associated with Alternative 3 would occur in the Silverfish PSU; Alternative 3 would not impact the gray wolf in the Silverfish PSU.

Alternative 3 would increase road densities in the Crazy PSU, but not as much as Alternative 2 due to road access changes (installation of gates or barriers and public access restrictions) included in the Wildlife Mitigation Plan (see section 2.5.7.3, *Wildlife Mitigation*) for Alternative 3. Increased road density could result in increased potential for human disturbance and an increased risk of human-caused wolf mortality. Alternative 3 would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, allowing poachers easy winter access to potential wolf habitat. Increased traffic could result in more wolves being killed by vehicles, although traffic increases are anticipated to be minimal (see section 3.20, *Transportation*). The Fishtrap pack does not occupy this area and would not likely be affected by Alternative 3. High road densities, increased human access, and disturbance from mine activities could impact other wolves using the Crazy PSU. Impacts to wolf habitat would be at least somewhat reduced through the agencies' land acquisition program, and would likely be more effective than MMC's proposed land acquisition program because more land would be protected. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

None of the developments or activities associated with Alternative 4 would occur in the Silverfish PSU; Alternative 4 would not impact the gray wolf in the Silverfish PSU. Impacts of Alternative 4 on the wolf would be the same as Alternative 3.

Alternative A – No Transmission Line

Alternative A would not affect the gray wolf and would not change existing conditions for prey base, denning and rendezvous sites, or space with minimal exposure to humans.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Prey Base

In Alternative B, current populations of elk and white-tailed deer would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions and the effects of Alternative B on these species are described in section 3.24.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known gray wolf den or rendezvous sites would be affected by Alternative B.

Sufficient Space with Minimal Exposure to Humans

During transmission line construction, Alternative B would increase road densities in the analysis area. Open road densities on National Forest System land would return to existing densities during transmission line operations and after reclamation. Although new roads on National Forest System land would be revegetated after transmission line construction, the roads would allow increased pedestrian access to potential wolf habitat, resulting in increased potential for human

disturbance and an increased risk of human-caused wolf mortality from poaching. Alternative B could result in an increased risk of human-caused mortality during transmission line construction due to increased traffic, although traffic increases are anticipated to be minimal and short-term (see section 3.20, *Transportation*). In Alternative B, helicopter line stringing, which would last about 10 days, could temporarily displace wolves from the transmission line corridor and surrounding habitat. Similar effects could occur from other transmission line construction activities associated in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could cause similar displacement during line decommissioning. Only the outer edge of the Fishtrap pack territory extends to the extreme southeast portion of the analysis area and the Fishtrap pack would not likely be affected by Alternative B. High road densities and transmission line construction activities could have short-term effects on other wolves using the analysis area. Impacts to wolf habitat would be somewhat reduced through MMC's proposed land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. Overall, Alternative B would have a minimal effect on the gray wolf.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Prey Base

In Alternative C, current populations of elk and white-tailed deer would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions and the effects of Alternative C on these species are described in section 3.24.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known den or rendezvous sites would be affected by Alternative C.

Sufficient Space with Minimal Exposure to Humans

Alternative C would increase road densities in the Crazy PSU, but not as much as Alternative B, due to road access changes included in the Wildlife Mitigation Plan (section 2.5.7.3, *Wildlife Mitigation*) for agencies' alternatives. Open road densities on National Forest System land would return to existing densities during transmission line operations and after reclamation. Although new roads on National Forest System land would be revegetated after transmission line construction, they would allow increased pedestrian access to potential wolf habitat, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality from poaching. Alternative C could result in an increased risk of human-caused mortality during transmission line construction due to increased traffic, although traffic increases are anticipated to be minimal and short-term (see section 3.20, *Transportation*). In Alternative C, helicopters would be used for stringing the entire transmission line and in some segments for vegetation clearing and structure placement, extending the duration of disturbance by about 2 months. Vegetation clearing and structure placement where helicopters were not used could contribute to short-term displacement of wolves. In Alternative C, except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B. Helicopter use and other activities could cause similar displacement during line decommissioning.

Only the outer edge of the Fishtrap pack territory extends to the extreme southeast portion of the analysis area, and the Fishtrap pack would not likely be affected by Alternative C. High road densities and transmission line construction activities could have short-term effects on other wolves using the analysis area. Impacts to wolf habitat would be at least somewhat reduced through the agencies' land acquisition program, and would likely be more effective than MMC's proposed land acquisition program because more land would be protected. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. Overall, Alternative C would have a minimal effect on the gray wolf.

Alternative D – Miller Creek Transmission Line Alternative

The impacts of Alternative D on gray wolves would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

The impacts of Alternative E on gray wolves would be the same as Alternative D.

Combined Mine-Transmission Line Effects

None of the activities associated with the mine alternatives would occur in the Silverfish PSU; all impacts to wolves in the Silverfish PSU would be due to the transmission line.

Prey Base

In all combined mine-transmission line alternatives, current populations of white-tailed deer and elk, the MIS for general forest species in the Crazy and Silverfish PSUs, would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions for these species are described in detail section 3.24.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known den or rendezvous sites would be affected by any of the combined mine-transmission line alternatives.

Sufficient Space with Minimal Exposure to Humans

All combined action alternatives would increase road densities in both the Crazy and Silverfish PSUs, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality. High road densities and transmission line construction activities could have short-term effects on other wolves using the analysis area. Road densities would increase the most for Alternative 2B in the Crazy PSU (BMU 5), and would remain worse than existing road densities until after mine closure. All combined action alternatives would include snowplowing Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, allowing poachers easy winter access to potential wolf habitat. Increases in open road densities in the Silverfish PSU would be short-term, and would diminish after transmission line construction. Although new roads on National Forest System land would be revegetated after transmission line construction, they would allow increased pedestrian access to potential wolf habitat, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality from poaching. Increased traffic could result in more wolves being killed by vehicles, although traffic increases are anticipated to be minimal in all combined action alternatives (see section 3.20, *Transportation*).

For all combined action alternatives, helicopter and other transmission line construction activities could temporarily displace wolves from the transmission line corridor and surrounding habitat. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C above. Only the outer edge of the Fishtrap pack territory extends to the extreme southeast portion of the analysis area, and the Fishtrap pack would not likely be affected by any of the combined action alternatives.

Impacts to wolf habitat could be reduced through MMC's or the agencies' land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. The agencies' land acquisition program would likely be more effective than MMC's proposed land acquisition program because more land would be protected. For the combined agencies' alternatives, potential impacts to wolves also would be minimized through road access changes (installation of gates or barriers and public access restrictions) that would create security habitat for prey species and reduce motorized access of wolf habitat. For all action alternatives, potential impacts to wolves also would be reduced by prohibiting employees from carrying firearms and removing road-killed big game animals. For the combined agencies' alternatives, implementation of a transportation plan to reduce mine traffic, and monitoring road-killed animals also would reduce mortality risks for wolves. All action alternatives include the funding of two grizzly bear specialist positions and one law enforcement position. Although the objective of these positions would be focused on reducing mortality risk for grizzly bears, they would likely indirectly benefit wolves by increasing public awareness of issues related to threatened and endangered species in general, and improving enforcement of road access changes. Overall, all combined action alternatives would have a minimal effect on the gray wolf.

Cumulative Effects

Cumulative effects of the combined mine-transmission line alternatives in combination with other reasonably foreseeable actions are not likely to change big game populations that provide prey for wolves. While cumulative losses of both cover and forage habitat would occur, areas disturbed as a result of the combined action alternatives and other reasonably foreseeable actions could provide additional forage habitat after reclamation, thereby improving habitat conditions for big game. Current populations of white-tailed deer and elk, the MIS for general forest species in the Crazy and Silverfish PSUs, would likely be maintained and would continue to provide a good year-round prey base for wolves. Existing habitat conditions and effects of the alternatives on big game species are described in section 3.24.3, *Management Indicator Species*.

No known den or rendezvous sites would be affected by any of the combined mine-transmission line alternatives and none would contribute to cumulative effects on wolf denning or rendezvous sites.

Cumulative effects of the combined action alternatives, in combination with other reasonably foreseeable actions, on the Fishtrap pack would likely be minimal because the Fishtrap territory does not go beyond the extreme southeast portion of the analysis area. Cumulative increases in road densities from the combined action alternatives, in combination with other reasonably foreseeable actions, could impact other wolves using the analysis area. Helicopter use and other construction activities associated with the combined action alternatives could also contribute to cumulative impacts on wolves, although their effects would be temporary. Impacts to wolf habitat would be at least somewhat reduced through road access changes land acquisition programs associated with grizzly bear and big game mitigation for the combined action alternatives and

reasonably foreseeable actions, especially the Rock Creek Project. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed.

3.24.5.2.4 Regulatory/Forest Plan Consistency

KFP. All action alternatives would comply with KFP direction on threatened and endangered species that applies to the gray wolf (KFP Vol. 1, II-1 #5 and II-23) and its prey base (KFP Vol. 1, II-1 # 3 and #12, II-7, and II-22-23).

Endangered Species Act. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF will submit a BA to the USFWS that describes the potential effect on threatened and endangered species that may be present in the area. After review of the BA and consultation, the USFWS will issue a BO for the proposed Montanore Project.

Statement of Findings. Alternative 2B may affect, but is not likely to adversely affect, the gray wolf for the following reasons:

- Sufficient populations of elk, deer, and other prey species would continue to be maintained and would continue to provide a good year-round prey base for wolves.
- No known den or rendezvous sites would be affected by any of the combined mine-transmission line alternatives.
- Overall road densities would increase in the analysis area and near the mine facilities. These increases would last until after mine closure and reclamation. Potential impacts to the gray wolf from increased road densities would be reduced through MMC's land acquisition program associated with grizzly bear mitigation. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve wolf habitat where roads could be closed.
- Other measures included in Alternative 2B that could reduce potential mortality risks associated with increased road densities include prohibiting employees from carrying firearms; removing road-killed big game animals; and funding of two grizzly bear specialists and one law enforcement position, which would likely indirectly benefit wolves through improved enforcement of access changes and by increasing public awareness of issues related to threatened and endangered species in general.

All combined agencies' alternatives may affect, but are not likely to adversely affect, the gray wolf for the following reasons:

- Sufficient populations of elk, deer, and other prey species would continue to be maintained, and would continue to provide a good year-round prey base for wolves. For the agencies' alternatives, access changes associated with big game and grizzly bear mitigation would create security habitat for prey species.
- No known den or rendezvous sites would be affected by any of the combined mine-transmission line alternatives.
- Combined agencies' alternatives would result in short-term increases in overall road densities and disturbance from helicopter use and other activities in the analysis area during transmission line construction. During the operations phase, road densities would improve due to road access changes (installation of gates or barriers and public

access restrictions) associated with big game and grizzly bear mitigation, minimizing mortality risks for wolves.

- Impacts to the wolf would be reduced through the agencies' land acquisition program associated with grizzly bear mitigation. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve wolf habitat where roads could be closed.
- Other measures to reduce mortality risks are prohibiting employees from carrying firearms; removing road-killed big game animals; implementation of a transportation plan to reduce mine traffic; and funding two grizzly bear specialists and one law enforcement position, which would likely indirectly benefit wolves through improved enforcement of access changes and by increasing public awareness of issues related to threatened and endangered species in general.

3.24.5.3 Grizzly Bear

3.24.5.3.1 Analysis Area and Methods

Grizzly bear population ecology, biology, habitat description, and relationships identified by research are described in Kasworm and Manley (1988), USFWS (1993), Johnson (2003), Kasworm *et al.* (2007), MMC (2005), and USDA Forest Service (2005c); and are incorporated herein by reference. Grizzly bear occurrence data come from recent District wildlife observation records, KNF historical data (NRIS FAUNA), other agencies (USFWS, FWP), and Westech (2005a). KNF GIS data was used for core grizzly bear habitat, BMUs, roads, and grizzly bear outside the recovery zone (BORZ) reoccurring use polygons.

The proposed project is in the Cabinet-Yaak Ecosystem grizzly bear recovery zone (USFWS 1993). The analysis area for project impacts to individuals and their habitat are the BMUs in the recovery zone and the BORZ polygon (Wittinger *et al.* 2002) potentially affected by the Montanore Project. Specifically, the analysis area is the Snowshoe, St. Paul, and Wanless BMUs (BMUs 2, 5, and 6, respectively) and the Cabinet Face BORZ polygon, including private and state lands (Figure 90). The boundary for cumulative effects and making the effects determination is BMUs 2, 5, and 6 and the Cabinet Face BORZ polygon.

Current grizzly bear standards and objectives are established by the KFP; consultations since 1987, including the 1995 Amended Biological Opinion and Incidental Take Statement on the KFP (USFWS 1995); and the Selkirk/Cabinet-Yaak Grizzly Bear Areas Interim Access Management Rule Set from December 1, 1998 (IGBC 1998).

Research conducted by Wakkinen and Kasworm (1997) in the Selkirk and Cabinet-Yaak Ecosystems that examined the concepts of open motorized route density (OMRD), total motorized route density (TMRD), and core habitat is considered "best science" applicable to the Montanore Project. Johnson (2007a) supports this position.

Effects of the proposed project may be influenced by grizzly bear seasonal use of potentially affected habitats. Grizzly bear use seasons have been defined through grizzly bear research. Although there may be considerable variation between individuals, based on Kasworm *et al.* (2007) and Johnson *et al.* (2008), seasons are defined as:

- Denning: December 1 – March 31

- Spring: April 1 – June 15
- Summer: June 16 – September 15
- Fall: September 16 – November 30
- Non-denning season: same as active bear year
- Active bear year: April 1 – November 30 (Johnson *et al.* 2008)

MMC's proposed Alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the yearlong access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include yearlong access changes through the installation of barriers or gates in several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in grizzly bear effects calculations. Additional road access changes also would occur on land acquired as part of the mitigation plans proposed by MMC and the agencies. Core, road density, and HE calculations do not take into account the effect of land acquisition programs proposed by MMC and the agencies described in the respective mitigation plans in sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*.

Analysis of Effects to Grizzly Bear Inside the Recovery Zone

The goal for grizzly bear management on the KNF is to provide sufficient quantity and quality of habitat to facilitate grizzly bear recovery. An integral part of the goal is to implement measures within the authority of the Forest Service to minimize human-caused grizzly bear mortalities. This goal is accomplished by achieving five objectives common to grizzly bear recovery as described by Harms (1990), and by a sixth objective specific to the KNF concerning acceptable incidental take (McMaster 1995). NFMA and ESA require the use of "best science" to complete environmental effects analyses. Johnson (2007a) supports research conducted by Wakkinen and Kasworm (1997) in the Selkirk and Cabinet-Yaak Ecosystems that examined the concepts of OMRD, TMRD, and core habitat as best science applicable to this area. Analyses used to evaluate whether or not objectives are being met are listed below each objective.

Objective 1: provide adequate space to meet the spatial requirements of a recovered grizzly bear population.

Percent habitat effectiveness. Habitat effectiveness (HE) is defined as the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity during the active bear year) remaining within a BMU after affected areas and Management Situation (MS) 3 lands are subtracted from the total habitat in the BMU. MS 3 lands are areas of high human use where grizzly bear presence is possible but infrequent and where conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged.

In calculating HE, the extent of a zone of influence depends on the type of activity, as recommended in the Cumulative Effects Analysis Process (USDA Forest Service 1988a). HE is calculated for all lands within an affected BMU, regardless of ownership. HE should be maintained equal to or greater than 70 percent of the BMU.

Core Area. A core area or core habitat is an area of high-quality grizzly bear habitat within a BMU that is greater than or equal to 0.31 mile from any road (open or restricted), or motorized

trail open during the active bear season. Core habitat may contain restricted-access roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth. Core is calculated by buffering roads, motorized trails, and high-use non-motorized trails on all lands, regardless of ownership, in a BMU (IGBC 1998). Best science indicates that at least 55 percent of a BMU should be core habitat (Wakkinen and Kasworm 1997). Federal agencies will work toward attaining a core area of at least 55 percent in the BMU and will allow no loss of core areas on federally-owned land within the BMU (IGBC 1998). New core habitat created to compensate for loss of previously existing core habitat by a project will: 1) be in place prior to conducting the activity; 2) be equal to or better in habitat quality (including seasonal components); 3) be at least equal in block size; and 4) kept in place through the entire period of the interim rule set.

Open motorized route density. OMRD is calculated for a BMU using moving window analysis. The moving window analysis is a technique for measuring road densities on a landscape using GIS. Results are displayed as a percent of the analysis area in relevant route density classes. OMRD is expressed as the percent of the entire BMU, regardless of ownership, with open road density greater than 1 mi/mi^2. Best science indicates that OMRD greater than 1 mi/mi^2 should not exceed 33 percent of a BMU (Wakkinen and Kasworm 1997). Federal agencies will allow no net increase in OMRD on federally-owned land within the BMU (IGBC 1998).

Total motorized route density. TMRD is calculated for a BMU using moving window analysis. TMRD is expressed as the percent of the entire BMU, regardless of ownership, with total route density greater than 2 mi/mi^2. Best science indicates that TMRD greater than 2 mi/mi^2 should not exceed 26 percent of a BMU (Wakkinen and Kasworm 1997). Federal agencies will allow no net increase in OMRD on federally-owned land within the BMU (IGBC 1998).

Linear open road density. Linear ORD is calculated for each BMU and should not exceed 0.75 mi/mi^2. Individual Active Bear Analysis Areas (BAAs) may exceed the standard for linear ORD if the BMU as a whole meets the standard; the BAA is where the activity is occurring; or the BAA has a higher ORD standard established as a result of prior consultation with the USFWS. Linear ORD is calculated for MS 1 lands only, regardless of ownership. MS l areas contain grizzly bear population centers and habitat components needed for the survival and recovery of the species or a segment of its population. MS 1 areas are managed for grizzly bear habitat maintenance, improvement, and minimization of grizzly bear-human conflict. Management decisions will favor the needs of the grizzly bear when grizzly habitat and other land use values compete.

Objective 2: Manage for an adequate distribution of bears across the ecosystem.

Opening size. Proposed actions in combination with existing unrecovered harvest units or natural openings should not create openings greater than 40 acres. When, for justified reasons, an opening exceeds 40 acres, no location in the opening should be greater than 600 feet from cover.

Movement corridors. Unharvested corridors greater than 600 feet in width should be maintained between proposed harvest units and existing harvest units and natural openings.

Seasonal components. Proposed activities should be scheduled to avoid spring habitats during the spring use period (April 1 to June 15). Activities in close proximity of known den sites should be avoided during the denning period (December 1 to March 31).

Road density and displacement (core) areas. Road density and displacement (core) areas are discussed in Objectives 1 and 6.

Objective 3: Manage for an acceptable level of mortality risk.

Most human-caused grizzly bear mortalities on the KNF are the result of interactions between bears and big game hunters (Kasworm and Manley 1988). Grizzly bear vulnerability to human-caused mortality is partially a function of habitat security. Mortality risk can be partially assessed by the use of habitat factors that maintain or enhance habitat security (Objectives 1, 2, and 6).

Attraction of grizzly bears to improperly stored food and garbage is identified by the Recovery Plan as one of the principal causes of grizzly bear mortality (USFWS 1993). Bears that lose their natural fear and avoidance of humans, usually as a result of food rewards, become habituated, and may become food-conditioned.

Objective 4: Maintain/improve habitat suitability with respect to bear food production.

Timber harvest and post-harvest treatments such as prescribed burning, when conducted within KFP standards, generally have a positive effect on the growth of forage plants important to bears. Riparian habitats are also generally considered valuable feeding sites.

Objective 5: Meet the management direction outlined in the Interagency Grizzly Bear Guidelines for Management Situation 1, 2, and 3.

Meeting Objectives 1 through 4 has been determined to meet the intent of the Interagency Grizzly Bear Guidelines for Objective 5 (Buterbaugh 1991).

Objective 6: Meet the interim management direction specified in the July 27, 1995 Forest Plan Incidental Take Statement (McMaster 1995) to avoid exceeding authorized incidental take levels.

Open road density. Manage the density of open roads within the KFP standard. See Objective 1 for details.

Open motorized trail density. Do not increase the existing density of open motorized trails in the affected BMU.

Total motorized route density. Manage all motorized access routes (open and restricted roads and motorized trails) in the affected BMU to avoid a net increase over the existing density. See Objective 1.

Existing core area size. Manage the amount of existing core area in the affected BMU to avoid a net decrease. See Objective 1.

Analysis of Effects to Grizzly Bear Outside the Recovery Zone

The USFWS has identified three factors falling under Forest Service jurisdiction that contribute to “take” (ESA Section 9) of grizzly bears that apply in BORZ polygons, as identified by Wittinger *et al.* (2002): 1) access management; 2) food attractants (human and livestock food storage and garbage); and 3) livestock presence. To reduce the potential for mortality and displacement of grizzly bears from occupied habitat in BORZ areas, KNF access management standards for BORZ areas were established based on the best science available (Johnson 2007b; Johnson 2007c). These standards are:

- The KNF will ensure no increases in linear open road (ORD) (*i.e.*, non-gated roads open to public use) densities on National Forest System lands in any individual area of grizzly bear occupancy, greater than existing conditions.
- The KNF will ensure no permanent increases in linear total road densities (TRD) on National Forest System lands greater than existing conditions. Temporary increases in linear total road densities are acceptable under the following conditions:
    - Newly constructed roads will be effectively gated and closed to public use.
    - Roads closed to meet the no net increase in linear total road densities will: 1) be closed immediately upon completion of activities requiring use of the road; 2) be effectively closed with a berm, guardrail, or other effective measure; and 3) put in a condition such that a need for motorized access for maintenance is not anticipated for at least 10 years.
    - Upon completion of a project, linear total road densities will return to pre-project densities.

The first 10.3 miles of NFS road #231 and first 4.7 miles of NFS road #278 are in the Cabinet Face BORZ polygon (Figure 90). Based on information from Johnson (2003), existing conditions for the Cabinet Face BORZ are 2.2 mi/mi^2 of linear ORD and 3.9 mi/mi^2 of linear TRD.

Impacts to grizzly bears on private and state land outside of the recovery zone from the transmission line alternatives were evaluated qualitatively, based on predicted changes in habitat quality, displacement effects during construction, operations, reclamation, changes in road densities, and potential for increased food attractants.

3.24.5.3.2 Affected Environment

Inside Recovery Zone

The grizzly bear population for the Cabinet-Yaak Ecosystem is currently estimated at 40 to 45 bears, including at least 15 bears in the Cabinet portion of the Cabinet-Yaak Ecosystem, with a 94 percent probability of a downward population trend (Kasworm *et al.* 2007). Because of the age structure and small size of the population, augmentation of the Cabinet grizzly bear population began in 1990. Four subadult female bears captured in southeast British Columbia were moved to the Cabinet Mountains for release from 1990 to 1994. None of the transplanted bears were wearing a functioning radio collar by the end of 1995. Two grizzly bears (adult female and subadult female) were moved from the North Fork Flathead River to the western Cabinet Mountains in 2005 and 2006. In the summer of 2008, two additional subadult female grizzly bears were moved from the Whitefish Range and Swan River to the eastern Cabinet Mountains. The bears translocated in 2008 were killed in October 2008 near Noxon, MT, one from a train strike and the other from an illegal shooting (Kasworm 2008).

Based on results of a 5-year radio-telemetry study conducted by FWP from 1983 to 1987, home ranges of three collared bears overlapped around the upper portions of Bear Creek, Cable Creek, Poorman Creek, and Ramsey Creek within BMU 5 (Kasworm and Manley 1988). Home ranges extended laterally from this area throughout BMUs 5 and 6. A large male grizzly captured in the Bull River drainage in 2005 spent considerable time in the upper Libby Creek drainage during the fall of 2005 and also the spring of 2006. This bear was located on numerous occasions less than 1 mile east of the Libby Adit Site. Bear activity in the Snowshoe, St. Paul, and Wanless BMUs is

summarized in Table 191. Grizzly bear habitat and habitat characteristics in the Snowshoe, St. Paul, and Wanless BMUs are listed in Table 192 and shown on Figure 90. All habitat standards and goals are met for BMUs 2 and 5. The standard for linear ORD is met in BMU 6; the standards and goals for the other habitat parameters are not met in this BMU.

Table 191. Credible Grizzly Bear Sightings, Credible Female with Young Sightings, and Known Human-Caused Mortality by BMU in 2004.

BMU #	Credible Grizzly Bear Sightings	Unduplicated Sightings of Females with Cubs	Sightings of Females with Yearlings or 2-Year Olds	Human-Caused Mortality
Snowshoe (2)	3	0	1	0
St. Paul (5)	5	1	3	0
Wanless (6)	4	0	2	0

Source: Kasworm *et al.* 2005.

Table 192. Existing Grizzly Bear Habitat Conditions by BMU.

BMU #	Percent Core Habitat	Percent OMRD >1 mi/mi^2	Percent TMRD >2 mi/mi^2	Linear ORD mi/mi^2	Percent Habitat Effectiveness
Snowshoe (2)	76 (≥55)	20 (no net increase)	14 (no net increase)	0.30 (≤0.75)	79 (≥70)
St. Paul (5)	60 (≥55)	27 (no net increase)	23 (no net increase)	0.52 (≤0.75)	72 (≥70)
Wanless (6)	**54** (≥55)	35 (no net increase)	33 (no net increase)	0.63 (≤0.75)	**66** (≥70)

Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987; USFWS (1995); IGBC (1998); and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).
Bolded values do not meet standards or goals.
BMU = Bear Management Unit.
ORD = open road density.
OMRD = open motorized route density.
TMRD = total motorized route density.
Source: USDA Forest Service 2007e.

Existing conditions for the BAAs within BMUs 2, 5, and 6 are available in the KNF project record. Activities associated with the mine alternatives would occur in BAAs 555 and 556 (BMU 5), while activities associated with the transmission line alternatives would occur in BAAs 556 (BMU 5), 566, and 567 (BMU 6). Linear ORD currently exceeds 0.75 mi/mi^2 within BAAs 555 and 556 (BMU 5), and BAA 566 (BMU 6). Reducing ORDs to 0.75 mi./mi^2 within BAAs 555, 556, and 566 would require an access change in main National Forest System loop roads or roads where status and management jurisdiction (Forest Service vs. County) is currently in question.

Several openings in forest cover greater than 40 acres occur in BMUs 2, 5, and 6, but no part of these openings is farther than 600 feet from forest cover. Several unharvested corridors greater than 600 feet occur between existing unrecovered harvest units.

Excellent year-round habitat components are present in BMUs 5 and 6, with documented use by grizzly bears (Kasworm and Manley 1988). Grizzly bear den sites in the Cabinet Mountains are generally in remote areas above 5,000 feet that have well-developed soils for excavation and adequate snow accumulation. The two closest known grizzly bear dens from the general Montanore Project area were found about 3 miles to the west in the upper Bear Creek and Cable Creek drainages. Spring grizzly bear habitat comprises about 63 percent of BMU 2, 72 percent of BMU 5, and 70 percent of BMU 6.

Human-caused mortality has been identified as one of the main factors in the demise of the grizzly bear in the Cabinet-Yaak Ecosystem (Kasworm and Manley 1988). At least 28 known human-caused mortalities were documented within 10 miles of the Cabinet-Yaak Recovery Zone (including Canada) from 1982 to 2006 (Kasworm *et al.* 2007). Thirteen of those mortalities have occurred from 2001 to 2006, including eight females.

During the 1980s, most documented grizzly mortalities in the Cabinet-Yaak Ecosystem were the result of interactions between bears and big game hunters (Kasworm and Their 1990). The relatively small size of the Cabinet Mountains portion of the ecosystem, coupled with high accessibility, creates a strong potential for the illegal shooting of grizzly bears (Kasworm and Knick 1989). In this regard, increased law enforcement along with better public education and awareness is of vital importance to grizzly recovery in the Cabinet-Yaak Ecosystem.

The maximum human-caused mortality level that can be sustained by a grizzly bear population before resulting in population decline is 6 percent, when no more than 30 percent of mortalities are female bears (Harris 1984). The goal for the Cabinet-Yaak Ecosystem is less than 4 percent human-caused mortality, with no more than 30 percent of total mortality consisting of female bears (USFWS 1993). Based on a minimum population estimate of 40 individuals (Kasworm *et al.* 2007), 4 percent mortality of the grizzly bear population in the Cabinet-Yaak Ecosystem would be equivalent to 0.7 bears per year (ibid.). Thirty percent female mortality would be equivalent to 0.2 females per year, or one female mortality every 5 years. Average annual human-caused mortality for 2001–2006 was 1.7 for all bears and 1.3 for females (ibid.). The Grizzly Bear Recovery Plan established a human-caused mortality goal of zero for this recovery zone because grizzly bear numbers are so small in this ecosystem (USFWS 1993).

Outside Recovery Zone

In 2005, the Cabinet Face BORZ polygon was not known to be occupied by any females with young, and no known mortality was reported for the polygon. Current linear ORD for the Cabinet Face BORZ is 2.2 mi/mi^2, while the TMRD is 3.9 mi/mi^2. Neither livestock nor food attractants are present in the Cabinet Face BORZ polygon on National Forest System lands. Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ polygon are a known attractant site. Black bears in particular have been a problem at this site.

With exception of small portions in the West Fisher Creek and Miller Creek drainages, which are in BMU 6, private and state land in the alternative transmission line corridors occurs entirely in the Cabinet Face BORZ polygon. Road densities are generally high on private and state land within the alternative transmission line corridors. Most previously harvested areas have well-

established conifer regeneration primarily dominated by dry, ponderosa pine/Douglas-fir communities, as described in section 3.21, *Vegetation*. Small areas of cottonwood or spruce/fir riparian providing potential feeding sites for grizzly bears occur in the Fisher River, West Fisher Creek, and Hunter Creek riparian corridors.

As described for elk in section 3.24.3, *Management Indicator Species*, a wildlife linkage zone has been identified in the Fisher River Valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2, and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (see KNF project records). U.S. 2 in the Fisher River Valley between Raven and Brulee creeks is a crossing area for grizzly bears moving between the Cabinet Mountains and the Salish Mountains (Brown, pers. comm. 2008).

3.24.5.3.3 Environmental Consequences

The effects of the combined mine-transmission line alternatives are shown in Table 195. Road access changes associated with mitigation were determined for the combined mine-transmission line alternatives. It is not possible to attribute these road access changes to individual mine and transmission line alternatives independent of one another. Thus, the evaluation of individual transmission line alternative impacts to grizzly bear is based on direct impacts and disturbance to bear habitat and access changes during transmission line construction, as shown in Table 193 and Table 194. Transmission line impacts to core, road densities, and HE may be inferred from impact calculations for the combined mine-transmission line alternatives. For example, for BMU 5 because core and ORD are similar for combined alternatives associated with Alternative 3 and combined alternatives associated with Alternative 4, the effects of the proposed project appear to be due primarily to the mine alternatives. In BMU 6, core and ORD would be primarily affected by the transmission line alternatives, and effects are similar for the combined alternatives associated with Alternatives C, D, and E.

Alternative A – No Transmission Line

Alternative A would not change existing conditions for the grizzly bear inside or outside the recovery zone.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Inside Recovery Zone

Alternative B would not affect the grizzly bear in BMU 2.

Physical habitat disturbance. Alternative B would result in the clearing of about 167 acres within BMUs 5 and 6, and the physical removal of about 40 acres of potential grizzly bear habitat as a result of new roads constructed (Table 193). In Alternative B, the new road prism would remain during transmission line operations, but roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. If revegetation were successful, disturbed areas would provide additional forage habitat as forage species become established.

Table 193. Physical and Displacement Impacts of Transmission Line Alternatives in the Analysis Area.

Measurement Criteria	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
Clearing on National Forest System Land in BMUs 5 and 6 (acres)[1]	0	167	156	163	192
Clearing on Private or State Land in the Cabinet Face BORZ (acres)[1]	0	132	170	182	163
Bear Habitat Physically Removed (acres)[2]	0	40	13	14	14
Temporary Displacement in Recovery Zone (acres)[3, 4]	0	7,164	5,254	6,856	10,980
Temporary Displacement Outside of Recovery Zone (acres)[3, 4]	0	7,737	7,328	6,720	5,521
Total Temporary Displacement (acres)[3, 4]	0	14,901	12,582	13,576	16,501

BORZ = grizzly bear outside the recovery zone reoccurring use polygon.

[1] Potential habitat in transmission line corridor, including the Sedlak Park Substation and loop line, may be altered but would remain useable habitat.

[2] Includes impacts of new roads constructed for transmission line at 4 acres per mile and Sedlak Park Substation.

[3] The effects of activities potentially resulting in the displacement of bears from their habitat is calculated by applying influence zones for point source and linear disturbances established in Christensen and Madel (1982) and USDA Forest Service (1988a). Displacement effects were calculated by applying a 1-mile buffer on each side of helicopter flight path. Displacement effects are shown for the worst-case scenario. Area of displacement effect includes areas where other activities may currently be contributing to displacement of grizzly bears. Displacement effects from new and open roads, clearing, and construction of structures associated with the transmission line alternatives are entirely encompassed by the helicopter displacement buffer. Area of displacement due to helicopter use does not include areas within influence zone of proposed motorized point 24-hour activity or existing roads that would be used for the Montanore Project.

[4] In Alternative B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used for logging or structure placement in Alternative B. Helicopter use was assumed for line stringing and maintenance and annual inspections only.

Table 194. Miles of Open, Closed, and New Access Roads Required for Transmission Line Construction.

Road Type	Alternative B – North Miller Creek	Alternative C – Modified North Miller Creek	Alternative D – Miller Creek	Alternative E – West Fisher Creek
Open Road				
Within a BMU (miles)	8.5	6.5	4.4	3.3
Within Cabinet Face BORZ (Bears Outside Recovery Zone) (miles)	11.8	16.2	15.3	8.7
Subtotal (miles)	20.3	22.7	19.7	12.0
Closed Road				
Within a BMU (miles)	11.7	1.4	0.3	6.9
Within core habitat (miles)*	0.2	0.0	0.0	0.0
Within Cabinet Face BORZ (miles)	0.1	1.4	1.4	3.4
Subtotal (miles)	11.8	2.8	1.7	10.3
New Road				
Within a BMU(miles)	6.5	0.8	1.1	2.0
Within Core Habitat (miles)	0.9*	0.0	0.0	0.0
Within Cabinet Face BORZ (miles)	3.4	2.2	2.2	1.5
Subtotal (miles)	9.9	3.0	3.3	3.5

*Core habitat mileage is included with the mileage of the "Within a BMU" category.
BMU = Bear Management.
BORZ = Bears Outside Recovery Zone.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation was re-established, redisturbed areas would again provide forage habitat.

MMC's land acquisition program (see section 2.4.6.3, *Grizzly Bear Mitigation Plan*) would, in the long term, result in additional habitat available for grizzly bear use. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition program would provide grizzly bear habitat over the long term. This additional habitat would be important in providing space and security for an increasing grizzly bear population.

Displacement and percent habitat effectiveness. Point source and motorized linear disturbance are recognized as having potential displacement effects on bears. The effects of activities potentially resulting in the displacement of bears from their habitat is calculated by applying influence zones for point source and linear disturbances established in Christensen and Madel (1982) and USDA Forest Service (1988a). Displacement effects shown in Table 193 are worst-case scenario and include areas where other activities may currently be contributing to the displacement of grizzly bears. Displacement effects from new and open roads, clearing, and

construction of structures associated with the transmission line alternatives are entirely encompassed by the helicopter displacement buffer.

In Alternative B, helicopter use and other construction activities would result in potential displacement effects to 14,901 acres of grizzly bear habitat. Helicopter line stringing would last about 10 days, and would result in short-term disturbance to grizzly bears. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Except for annual inspection and infrequent maintenance operations, which would last about 10 days, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities would cause similar disturbances with similar durations during line decommissioning.

Increased displacement effects would result in a decrease in HE, especially during transmission line construction. Because it is not possible to attribute road access changes associated with mitigation to transmission line alternatives independent of mine alternatives, HE was not calculated for Alternative B, but can be inferred from Table 195. Displacement effects from helicopter use and other construction activities would have the greatest impact on HE in BMU 6, where HE is currently below the recommended level.

Displacement effects and impacts on HE would diminish after transmission line construction because helicopter line construction would cease and roads opened or constructed for transmission line access would be gated or barriered after transmission line construction. In Alternative B, infrequent disturbance to grizzly bears would occur during transmission line operations as a result of annual inspections and maintenance conducted by helicopter. Helicopters would be used for line decommissioning. Scientific literature suggests that high frequency helicopter use, particularly at low altitudes, in grizzly bear habitat can result in adverse effects on grizzly bears (Montana/Northern Idaho Level I Team 2006). Disturbance from helicopters may result in flight responses and other behavioral changes, increased heart rate and other physiological changes, displacement to lower quality habitat, and increased energetic demands (Ibid.). When the transmission line was decommissioned following mining, the access roads would be reopened, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated. After reclamation, the HE would return to existing levels.

To mitigate for habitat losses not offset by access changes, Alternative B includes the protection of private lands through acquisition or conservation easement. Displacement effects would be reduced through MMC's land acquisition program. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition program would partially offset the Alternative B impacts to habitat effectiveness through road access changes and elimination of sources of grizzly bear disturbance, where possible.

Core habitat and open road densities. Alternative B would increase linear ORD to about 0.71 mi/mi^2 in BMU 6 during construction, but would remain better than the standard. Linear ORD in BMU 6 would be the same as existing conditions after reclamation. Alternative B would have the greatest effects on OMRD in BMU 6, increasing OMRD to 38 percent during construction. In Alternative B, OMRD in BMU 6 would be the same as existing conditions during operations and after reclamation. In BMU 6, Alternative B would increase TMRD during construction and

operations, but would return to existing densities after reclamation. Construction of Alternative 2B would decrease core habitat to 53 percent in BMU 6 during construction, where core habitat is currently worse than recommended levels; it can be inferred from these results that Alternative B would have similar effects on core habitat. Impacts to core habitat would be partially reduced through MMC proposed land acquisition program. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and could contribute additional core habitat where core habitat conditions occurred and where roads were barriered.

Small, isolated blocks of core habitat may provide lower quality habitat than large, interconnected blocks. Research suggests that grizzly bears prefer larger blocks of core, although a minimum block size was not determined due to small sample sizes (Wakkinen and Kasworm 1997). During transmission line construction, new road construction in Alternative B would divide and reduce a block of core habitat in the northeast portion of BMU 6, where a narrow band of core habitat occurs, resulting in one large block and two smaller blocks from project construction until the transmission line was decommissioned. Displacement effects from helicopter activity during line stringing, annual maintenance throughout the project, and transmission line decommissioning would reduce effectiveness of this core habitat block. Core grizzly bear habitat would be altered with a linear transmission line corridor, reducing cover and increasing forage habitat. Clearing of the transmission line corridor could result in improved hunter access, increasing mortality risk.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative B. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative B, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative B components or activities would affect linkage zones identified by Servheen *et al.* (2003). Alternative B could deter grizzly bears from moving along the Miller Creek, Howard Creek, and Ramsey Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. In Alternative B, no motorized activity associated with transmission line construction would occur from April 1 to June 15 within bear habitat in the Miller Creek and Midas Creek drainages; timing restrictions in other areas would not be applied. Alternative B developments and activities would occur entirely in grizzly bear spring range. Disturbance due to noise and the presence of humans and machinery would have the greatest impact on grizzly bears if conducted in the spring (April 1 to June 15). Mitigation to secure currently disturbed spring habitat through other access management actions would be implemented.

Mortality risk. In Alternative B, food attractants would be minimized through the use of bear-resistant garbage containers, prohibiting the feeding of bears by mine employees, and the prompt removal of roadkill. Although new transmission line access roads would be gated or barriered after transmission line construction, mortality risks could increase due to improved hunter or poacher access. Mortality risks due to improved hunter or poacher access would increase more for Alternative B than for other transmission line alternatives because more new roads would be built (Table 194). Under MMC's proposed alternative, MMC would fund two new FWP wildlife positions—a bear specialist and a law enforcement officer. Public education about grizzly bears and enforcement of laws protecting grizzly bears would minimize mortality risks.

Outside Recovery Zone

On National Forest System lands, Alternative B would not measurably change existing conditions for linear ORD and TRD, livestock grazing, or the availability of food attractants for the grizzly bear in the Cabinet Face BORZ.

Alternative B would involve the construction of about 3.4 miles of new access road on private land in the Cabinet Face BORZ (Table 194). Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. Helicopter use during construction of Alternative B could result in increased disturbance to grizzly bears on private land, potentially displacing them from suitable habitat. New access roads, helicopter use, and other construction activities would likely have minimal impacts to grizzly bears because road densities are currently high on private and state land within the Alternative B transmission line corridor, the area is infrequently used by grizzly bears, and public education and law enforcement efforts of the bear specialist and law enforcement officer would minimize the risk of increased grizzly bear mortality.

The clearing area for Alternative B includes about 132 acres of private lands in the Cabinet Face BORZ. Actual clearing would likely be less, depending on tree height, slope, and line distance above the ground. Most of these lands have been logged in the past 20 to 30 years. Construction of the Sedlak Park Substation and loop line would result in the loss of about 4.4 acres of previously harvested coniferous forest. With the exception of the substation site and new access roads, disturbed areas would be revegetated after transmission line construction, potentially providing additional forage habitat for grizzly bears. On private land in the Cabinet Face BORZ, the clearing area for Alternative B includes about 9 acres of wetlands/riparian habitat, providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of MMC's proposed grizzly bear mitigation plan (see section 2.4.6.3.1, *Habitat Protection*) and the Environmental Specifications (Appendix D).

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife linkage zone in the Fisher River Valley. The proximity of this alignment to U.S. 2 would result in a widening of disturbed area and could potentially discourage grizzly bear movement within the linkage zone by decreasing cover. Transmission line construction activities could affect grizzly bear movement within this linkage zone, but these effects would be short-term because human-caused disturbance would cease when the transmission line construction was completed. Once revegetated, cleared areas could provide additional forage habitat. Some shrub and tree cover would be maintained in the transmission line right-of-way because only the largest trees would be removed. Given that the area of the linkage zone potentially affected by Alternative B is generally heavily roaded and has been logged in the past 20 to 30 years, and given the short-term nature of human-caused disturbance, it is not likely that grizzly bear movement within the linkage zone would be greatly affected by Alternative B.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Alternative C would result in the clearing of about 156 acres within BMUs 5 and 6, and the physical removal of about 13 acres of potential grizzly bear habitat

as a result of new roads (Table 193). All roads on National Forest System lands would be placed in intermittent stored service. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need.

National Forest System land. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. New transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. Once vegetation was re-established, redisturbed areas would again provide forage habitat. Reclamation of all disturbed areas would be similar to Alternative B.

To mitigate for habitat losses not offset by access changes, agencies' alternatives include the protection of private lands through acquisition or conservation easement. The agencies' land acquisition program would, in the long term, result in additional habitat available for grizzly bear use. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition program would likely result in a net gain in grizzly bear habitat over the long term. This additional habitat would be important in providing space and security for an increasing grizzly bear population.

Displacement and percent habitat effectiveness. In Alternative C, helicopters would be used for logging, structure placement, line stringing, annual inspections and maintenance, and line decommissioning, resulting in potential displacement effects to 12,582 acres of grizzly bear habitat. As with Alternative B, helicopter disturbance could be prolonged for up to 2 months. Vegetation clearing and structure placement where helicopters were not used could also contribute to short-term displacement effects. Some areas affected by displacement from transmission line activities are currently being affected by other activities such as road use. Alternatives B and C would follow similar routes, with the exception of the segment of Alternative B in the Ramsey Creek drainage. Alternative C would increase short-term helicopter displacement effects during construction but would reduce road requirements relative to Alternative B. Displacement effects from new and open roads, clearing, and construction of structures associated with the transmission line alternatives occur entirely within the helicopter displacement buffer. Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. Effects of high frequency helicopter use, particularly at low altitudes, are discussed in Alternative B.

Increased displacement effects would decrease HE, especially during transmission line construction. Because it is not possible to attribute road access changes associated with mitigation to transmission line alternatives independent of mine alternatives, HE was not calculated for Alternative C, but can be inferred from Table 195. Displacement effects from helicopter use and other construction activities would have the greatest impact on HE in BMU 6, where HE is currently below the recommended level. Displacement effects and reduction in HE after transmission line construction would be the same as Alternative B.

The agencies' alternatives include considerably more acquisition or placement of conservation easements on private land than Alternative B. The agencies' land acquisition program would, in the long term, result in additional habitat available for grizzly bear use. The land acquisition

program would likely result in a net gain in grizzly bear habitat effectiveness through road access changes and elimination of sources of grizzly bear disturbance, where possible.

Core and open road densities. During construction, Alternative C would increase linear ORD to 0.67 mi/mi^2 in BMU 6, but would remain better than the standard. In Alternative C, linear ORD would return to existing densities after transmission line construction. Alternative C would increase OMRD in BMU 6, where OMRD is worse than the standard, to 37 percent during construction. OMRD would return to existing densities after transmission line construction. In Alternative C, TMRD would not change in BMU 6 during construction, and would be better than existing conditions after transmission line construction. In BMU 6, where core habitat is currently worse than recommended levels, Alternative C would improve core habitat to better than recommended levels during all phases of the project.

The transmission line alignment in Alternative C would cross a block of core habitat in the northeast portion of BMU 6, but would not reduce core habitat because helicopters would be used for construction in or adjacent to core habitat. Similar to Alternative B, displacement effects from helicopter activity during construction, annual maintenance throughout the project, and transmission line decommissioning in Alternative C would reduce effectiveness of this core habitat block during transmission line construction. Alternative C includes an access change in the upper 2.8 miles of NFS road #4725 that would enlarge the block of core habitat in the northeast portion on BMU 6 after the road was no longer needed for transmission line construction. The effects of habitat alteration of core habitat due to clearing in the transmission line corridor would be the same for Alternative C as Alternative B.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative C. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative C, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative C components or activities would affect linkage zones identified by Servheen *et al.* (2003). Alternative C could deter grizzly bears from moving along the Miller Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. In Alternative C, timing restrictions would not be applied. Alternative C developments and activities would occur entirely in grizzly bear spring range. Disturbance due to noise and the presence of humans and machinery would have the greatest impact on grizzly bears if conducted in the spring (April 1 to June 15). Road access changes associated with Alternative C mitigation would secure currently disturbed spring habitat. Quality and quantity of spring habitat also would be improved through agencies' land acquisitions and habitat improvements.

Mortality risk. In Alternative C, food attractants would be minimized within the Recovery Zone, the same as Alternative B. Mortality risks due to improved hunter or poacher access would be less for Alternative C than Alternative B because fewer new roads would be built (Table 194). In addition to the bear specialist and law enforcement positions funded by MMC in Alternative B, Alternative C includes the funding by MMC of an additional bear specialist. Public education about grizzly bears and enforcement of laws protecting grizzly bears would minimize mortality risks.

Outside Recovery Zone

Alternative C would not measurably change existing conditions on National Forest System lands for linear ORD, TRD, or livestock grazing. In Alternative C, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ polygon, reducing the availability of food attractants and reducing mortality risks for the grizzly bear in the Cabinet Face BORZ. Alternative C would require the construction of about 2.2 miles of new access road on private land in the Cabinet Face BORZ (Table 194). Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. Helicopter use during construction of Alternative C could result in increased disturbance to grizzly bears on private land, potentially displacing them from suitable habitat. New access roads associated with Alternative C on private land would likely have minimal impacts to grizzly bears because road densities are currently high on private land within the Alternative C transmission line corridor, the area is infrequently used by grizzly bears, and public education and law enforcement efforts of the bear specialists and law enforcement officer would minimize the risk of increased grizzly bear mortality.

The clearing area for Alternative C includes about 170 acres of private lands in the Cabinet Face BORZ. Actual clearing would likely be less, depending on tree height, slope, and line distance above the ground. Most of these lands have been logged in the past 20 to 30 years. Construction of the Sedlak Park Substation and loop line would result in the loss of about 4.4 acres of previously harvested coniferous forest. With the exception of the substation site and new substation access roads, disturbed areas would be revegetated after transmission line construction, potentially providing additional forage habitat for grizzly bears. On private land in the Cabinet Face BORZ, the clearing area for Alternative C includes about 2 acres of wetlands/riparian habitat, providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of the agencies' Wetland Mitigation Plan (section 2.5.7.1, *Wetland Mitigation*) and Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). As specified in the agencies' Wildlife Mitigation Plans (sections 2.5.7.3, *Wildlife Mitigation* and 2.9.4, *Wildlife Mitigation Measures*), all shrub habitat would be retained in wetlands and riparian areas crossed by the proposed transmission line, minimizing impacts to grizzly bear forage habitat.

A relatively small portion of the Alternative C transmission line would cross the Fisher River Valley in the Fisher River wildlife linkage zone, potentially discouraging grizzly bear movement in a localized area due to transmission line construction activities. These effects would be short-term because human-caused disturbance would cease when the transmission line was built. The portion of Alternative C that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect grizzly bear movement in the linkage zone. Given that the area of the linkage zone potentially affected by Alternative C is generally heavily roaded and has been logged in the past 20 to 30 years, and given the short-term nature of human-caused disturbance, it is not likely that this alternative would greatly affect grizzly bear movement within the Fisher River Valley linkage zone.

Alternative D – Miller Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Physical habitat disturbance resulting from Alternative D would be the same as Alternative C, except that Alternative D would disturb about 163 acres within BMUs 5 and 6 and physically remove about 14 acres of grizzly bear habitat as a result of new roads (Table 193). The effects of the mitigation would be the same as Alternative C.

Displacement and percent habitat effectiveness. Impacts to displacement and habitat effectiveness from Alternative D would be the same as Alternative C, except that in Alternative D, helicopter construction and line stringing would result in potential displacement effects to 13,576 acres of grizzly bear habitat. Mitigation for impacts to displacement and habitat effectiveness would be the same as Alternative C.

Core and open road densities. During all phases, Alternative D would not change linear ORD or OMRD in BMU 6, and would improve TMRD in BMU 6. Alternative D would increase percent core habitat in BMU 6 to better than recommended levels. Alternative D includes an access change in NFS road #4725 that would enlarge a narrow band of core habitat in the northeast portion on BMU 6. The access change would be in the entire length of NFS road #4725 and would be implemented before transmission line construction started.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative D. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative D, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative D components or activities would affect linkage zones identified by Servheen *et al.* (2003). Alternative D could deter grizzly bears from moving along the Miller Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. The impacts of Alternative D on grizzly bear seasonal habitat use would be the same as Alternative C.

Mortality risk. Effects on mortality risk from Alternative D would be the same as Alternative C.

Outside Recovery Zone

On National Forest System National Forest System lands, Alternative D would not measurably change existing conditions for linear ORD and TRD or livestock grazing. In Alternative D, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ polygon, reducing the availability of food attractants for the grizzly bear in the Cabinet Face BORZ. Impacts to grizzly bears from Alternative D on private land in the Cabinet Face BORZ would be the same as Alternative C, except that the clearing area for Alternative D includes about 182 acres (Table 193 and Table 194).

Impacts of Alternative D on grizzly bears in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Physical habitat disturbance resulting from Alternative E would be similar to Alternative D, except that Alternative E would disturb about 192 acres within BMUs 5 and 6 (Table 193). The effects of the mitigation would be the same as Alternative C.

Displacement and percent habitat effectiveness. Impacts to displacement and habitat effectiveness from Alternative E would be the same as Alternative D, except that in Alternative E, helicopter construction and line stringing would result in potential displacement effects to 16,501 acres of grizzly bear habitat. Mitigation for impacts to displacement and habitat effectiveness would be the same for Alternative E as Alternative C.

Core and open road densities. During construction, Alternative E would increase linear ORD the most in BMU 6, but would remain better than the standard. Linear ORD would return to existing densities after transmission line construction. Effects of Alternative E on OMRD would be the same as Alternative C. In BMU 6, effects of Alternative E on TMRD and core habitat would be the same as Alternative D. Alternative E includes the same access change in NFS road #4725 as Alternative D that would enlarge a narrow band of core habitat in the northeast portion on BMU 6.

Opening size. No new non-linear openings in forest cover greater than 40 acres would be created by Alternative E. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative E, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative E components or activities would affect linkage zones identified by Servheen *et al.* (2003). Alternative E could deter grizzly bears from moving along the West Fisher Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. The impacts of Alternative E on grizzly bear seasonal habitat use would be the same as Alternative C.

Mortality Risk. Effects on mortality risk from Alternative E would be the same as Alternative C.

Outside Recovery Zone

On National Forest System lands, Alternative E would not measurably change existing conditions for linear ORD and TRD or livestock grazing. In Alternative E, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ polygon, reducing the availability of food attractants for the grizzly bear in the Cabinet Face BORZ. Impacts to grizzly bears from Alternative E on private and state land in the Cabinet Face BORZ would be the same as Alternative D, except that Alternative E would involve the construction of about 1.5 miles of new access road (Table 194), and the clearing area for Alternative E includes about 163 acres (Table 194 and Table 193), including about 17 acres of wetlands/riparian habitat.

Impacts of Alternative E on grizzly bears in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Combined Mine-Transmission Line Effects

Alternative 1A would not change existing conditions for the grizzly bear inside or outside the recovery zone. None of the action alternatives would change existing conditions for the grizzly bear in BMU 2.

Inside Recovery Zone

Percent habitat effectiveness. All of the combined action alternatives would decrease HE to worse than the recommended level in BMUs 5 and 6 during transmission line construction and operations (Table 195), mostly due to displacement effects from helicopter line stringing and construction. For all combined action alternatives, helicopter and other activities associated with transmission line construction could result in short-term disturbance to grizzly bears. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C above.

For Alternatives 4C, 4D, and 4E, HE would improve compared to existing levels in BMUs 5 and 6 after reclamation. HE would return to existing levels in BMUs 5 and 6 after reclamation in all other combined action alternatives.

During construction and operations, the combined agencies' alternatives would have the same effects on HE in BMU 5, reducing HE to 68 percent during construction and 70 percent during operations. Alternative 2B would have greater effects to HE in BMU 5 than the other alternatives, reducing HE to 61 percent during construction and 66 percent during operations, mostly because effects of the Ramsey Plant Site would occur in a separate drainage than other mine features.

In BMU 6, Alternatives 3E and 4E would reduce HE the most during construction due to a larger extent of helicopter use and other construction activities. Alternatives 2B, 3C, and 4C would reduce HE in BMU 6 the least during construction. During operations, Alternatives 2B, 3C, and 4C would decrease HE in BMU 6 the most because an access change in the lower segment of NFS road #4725 would occur for Alternatives 3D, 4D, 3E, and 4E only.

In all combined action alternatives, impacts to HE would be reduced through MMC and agencies' land acquisition programs. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' land acquisition program would likely result in a net gain in grizzly bear habitat effectiveness, through road access changes and elimination of sources of grizzly bear disturbance, where possible.

Linear open road density. All of the combined action alternatives would result in increases in linear ORD in BMU 5 during construction and operations, and in BMU 6 during construction. Linear ORD resulting from Alternative 2B construction would be 0.78 mi/mi^2 in BMU 5, which would be worse than the standard. During construction, Alternative 2B would increase ORD in BAAs 555 and 556, where current ORD is worse than the standard. Results of the analysis of the effects of the combined mine-transmission line alternatives on ORD in the individual BAAs are in the KNF project record.

Table 195. Grizzly Bear Habitat Effects by Combined Mine-Transmission Line Alternative[1].

Habitat Component	[1A] No Action/ Existing Conditions	[2] MMC's Proposed Mine			[3] Agency Mitigated Poorman Impoundment Alternative									[4] Agency Mitigated Little Cherry Creek Impoundment Alternative								
		TL-B			TL-C			TL-D			TL-E			TL-C			TL-D			TL-E		
		C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R
BMU 2																						
Core %	76 (≥55 or no loss)	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
OMRD %	20 (no net increase)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
TMRD %	14 (no net increase)	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
HE %	79 (≥70)	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
Linear ORD	0.30 (≤0.75)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
BMU 5																						
Core %	60 (≥55 or no loss)	**58**	**58**	**59**	65	66	66	65	65	66	65	65	66	65	65	66	65	65	66	65	65	66
OMRD %	27 (no net increase)	32	30	26	29	29	26	29	29	26	29	29	26	29	29	25	29	29	25	29	29	25
TMRD %	23 (no net increase)	26	26	21	20	18	18	20	18	18	20	20	18	20	20	17	20	20	17	20	20	17
HE %	72 (≥70)	**61**	**66**	72	**68**	70	72	**68**	70	72	**68**	70	72	**68**	70	73	**68**	70	73	**68**	70	73
Linear ORD	0.52 (≤0.75)	**0.78**	0.65	0.50	0.62	0.62	0.47	0.63	0.62	0.47	0.63	0.62	0.47	0.60	0.60	0.46	0.60	0.60	0.46	0.61	0.60	0.46
BMU 6																						
Core %	**54** (≥55 or no loss)	**53**	**53**	**53**	55	56	56	57	57	57	57	57	57	55	56	56	57	57	57	57	57	57
OMRD %	35 (no net increase)	38	35	35	37	35	35	35	35	35	37	35	35	37	35	35	35	35	35	37	35	35
TMRD %	33 (no net increase)	34	34	33	33	32	32	32	32	32	32	32	32	33	32	32	32	32	32	32	32	32
HE %	**66** (≥70)	**62**	**64**	66	**62**	**64**	66	**61**	**65**	66	**59**	**65**	66	**62**	**64**	66	**61**	**65**	66	**59**	**65**	66
Linear ORD	0.63 (≤0.75)	0.71	0.63	0.63	0.67	0.63	0.63	0.63	0.63	0.63	0.74	0.63	0.63	0.67	0.63	0.63	0.63	0.63	0.63	0.74	0.63	0.63

[1] The habitat parameters in this table do not reflect potential improved conditions that could result from required land acquisitions associated with mitigation for each alternative. Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987; USFWS (1995); IGBC (1998); and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).

For existing conditions, bolded values do not meet standards or goals. For alternatives, bolded values do not meet standards or goals, and do not maintain or improve conditions for that habitat parameter. Habitat parameters that do not meet standards or goals but that are not worse than existing conditions are not bolded. Compliance with OMRD and TMRD direction is based on reclamation phase values only.

TL = Transmission Line Alternative.

C = Construction Phase – shown with mitigation in place as mitigation plan requires this before start of construction phase.

O = Operation Phase – includes all mitigation in place.

R = Reclamation Phase (post project) – includes all mitigation in place.

BMU = Bear Management Unit.

ORD = open road density, measured in mi/mi^2.

OMRD = open motorized route density.

TMRD = total motorized route density.

HE = habitat effectiveness.

None of the combined agencies' alternatives would increase linear ORD to worse than the standard in BMU 5. Of the combined agencies' alternatives, Alternatives 3D and 3E would result in the greatest linear ORD in BMU 5 during construction. After reclamation, linear ORD in BMU 5 from all combined action alternatives would decrease below existing densities.

In all combined action alternatives, linear ORD in BMU 6 would be the same as existing conditions during operations and after reclamation. None of the combined action alternatives would result in linear ORD in BMU 6 worse than the standard. Due to the greater number of new roads needed for Alternative E, Alternatives 3E and 4E would increase linear ORD in BMU 6 the greatest during construction. Alternatives 3D and 4D would increase ORD in BMU 6 the least during construction.

Open motorized route density. All combined action alternatives would increase OMRD in BMU 5 during construction and operations (Table 195). Alternative 2B would have the greatest effects on OMRD in BMU 5, increasing OMRD to 32 percent during construction and 30 percent during operations. OMRD in BMU 5 would be similar in all agencies' alternatives, except after reclamation. OMRD in BMU 5 would improve compared to existing densities after reclamation in all combined action alternatives, decreasing by 2 percent for Alternatives 4C, 4D, and 4E; and 1 percent for Alternatives 2B, 3C, 3D, and 3E. Compliance with OMRD direction is based on values after reclamation.

OMRD in BMU 6 during construction would be worse than existing densities for Alternatives 2B, 3C, 3E, 4C, and 4E. OMRD in BMU 6 would increase more in Alternative 2B than other alternatives. OMRD in BMU 6 would return to existing densities during operations and after reclamation in all combined action alternatives.

Total motorized route density. In BMU 5, TMRD would increase the most during construction and operations of Alternative 2B to 26 percent. After reclamation, TMRD would be better than existing densities in BMU 5 for Alternative 2B. TMRD in BMU 5 would be better than existing densities for all phases of the combined agencies' alternatives, improving by 5 to 6 percent after reclamation (Table 195). Compliance with OMRD direction is based on densities after reclamation.

In BMU 6, TMRD would be the greatest during construction and operations of Alternative 2B, where TMRD would be 34 percent. TMRD would be 32 percent, or 1 percent better than existing densities, for Alternatives 3D, 3E, 4D, and 4E during construction and operations. During construction of Alternatives 3C and 3D, TMRD would be 33 percent because an access change in the lower segment of NFS road #4725 would occur for transmission line Alternatives 3D, 4D, 3E and 4E only. In all combined action alternatives, TMRD in BMU 6 would be the same as or slightly better than existing densities after reclamation.

Core areas. Relative to other combined action alternatives, Alternative 2B would have the greatest impact on core habitat in BMU 5 (Table 195). Alternative 2B would reduce core habitat in BMU 5 to 58 percent during construction and operations, and would result in less core habitat than existing levels after reclamation, mostly due to the effects of the Ramsey Plant Site. Combined agencies' alternatives would improve core habitat in BMU 5 during all phases of the proposed project as a result of road access changes and less new road construction along the transmission line corridors. Core in BMU 5 would be better than the recommended level in all combined action alternatives during all phases of the proposed project.

In BMU 6, Alternative 2B would decrease core habitat to 53 percent during all phases of the project. All combined agencies' alternatives would improve core habitat by between 1 and 3 percent in BMU 6 during all phases of the project as a result of road access changes and less new road construction along the transmission line corridors. All combined agencies' alternatives include an access change in NFS road #4725 that would improve core habitat in BMU 6. In Alternatives 3D, 4D, 3E, and 4E, the access change would be in the entire length of NFS road #4725 and would be implemented before transmission line construction started. The entire length of NFS road #4725 would be used during construction of Alternatives 3C and 4C, and the access change would occur in the upper 2.8 miles of NFS road #4725 after it was no longer needed for transmission line construction. For Alternatives 3C and 4C, less core habitat would be created than for Alternatives 3D, 4D, 3E, and 4E and core habitat creation would occur later.

The transmission line routes for combined alternatives 2B, 3C, and 4C would cross a narrow band of core habitat in the northeast portion of BMU 6. The effects of the combined alternatives to this core habitat block are described above for the corresponding transmission line alternatives.

In all combined action alternatives, impacts to core habitat would be reduced through MMC and agencies' land acquisition programs. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and could contribute additional core habitat where core habitat occurred and where roads were barriered. This additional habitat would be important in providing space and security for an increasing grizzly bear population. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects.

Opening size. All combined action alternatives would result in one linear opening in forest cover greater than 40 acres as a result of surface disturbance associated with the transmission line. No location in the transmission line clearing area would be greater than 600 feet from cover. In all combined action alternatives, surface disturbance from the impoundments would result in the consolidation of two smaller openings into one large opening. Alternatives 2B, 3C, 3D, and 3E would create three additional openings with locations in the opening greater than 600 feet from cover as a result of other mine components. Mine components of Alternatives 4C, 4D, and 4E would create four additional openings with locations in the opening greater than 600 feet from cover.

Movement corridors. In all combined action alternatives, except for impoundment disturbance, unharvested corridors greater than 600 feet would continue to be maintained between the proposed activity and unrecovered existing harvest units. On a larger scale, movement corridors consisting of blocks of vegetative cover and core habitat are available across BMUs 5 and 6. None of the combined alternative components or activities would affect linkage zones identified by Servheen *et al.* (2003). All combined action alternatives could deter grizzly bears from moving along upper portions of the Libby Creek corridor. Alternatives 2B, 4C, 4D, and 4E could also disrupt grizzly bear movement in the Little Cherry Creek riparian area. Alternative 2B would have additional effects on grizzly bear movement in the Ramsey Creek corridor. These displacement effects would potentially last until mine closure. Due to disturbance associated with transmission line construction, Alternatives 2B, 3C, 3D, 4C, and 4D could deter grizzly bears from moving along the Miller, and Howard creek corridors. Alternatives 3E and 4E could affect grizzly bear movement along the West Fisher and Howard creek corridors. Potential disruption of grizzly bear movement during transmission line construction would subside during operations.

The combined agencies' alternatives would include the protection (through acquisition or conservation easement) of about 5 acres of grizzly bear habitat that would enhance the north to south habitat corridor in the Cabinet Mountains.

Seasonal components. In all combined action alternatives, mine-related activities would occur continuously along the east Cabinet front during the spring period (April 1 to June 15) throughout the life of the project. Alternative 2B would result in a long-term disturbance in the upper Ramsey Creek drainage, which lies directly adjacent to the CMW and core grizzly bear habitat. In all combined action alternatives, mine-related activities in Libby Creek also would occur in proximity of the CMW and core grizzly bear habitat. Bears that may have traditionally used the impacted areas during the spring would likely have to adjust their normal behavior patterns, perhaps seeking foraging sites in less productive areas or areas closer to human disturbance. Due to the magnitude and duration of the disturbance at the Ramsey Plant Site, Libby Plant Site, and Libby Adits, and the limited amount of foraging options available to bears in the spring, changes in spring habitat use may have adverse consequences for grizzly bear survival.

In all combined action alternatives, impacts to bears in spring would be reduced through MMC and agencies' land acquisition programs. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and could secure additional spring habitat where conditions were appropriate. One of the goals of the agencies' grizzly bear mitigation is to protect seasonally important habitats, with a primary emphasis on spring, and secondary emphasis on fall habitats.

Mortality risk. As a result of activity at the Ramsey Plant site and Libby Plant Site, bears may be displaced from important seasonal foraging areas during critical periods, and may need to seek foraging sites in areas closer to human disturbance. Displacement into habitat less secure from humans can result in increased mortality for bears (USFWS 1993).

As described in section 3.17, *Social/Economics*, it is assumed in all combined action alternatives that some temporary housing facilities would be developed near the project site on private lands, increasing the potential for grizzly bear mortality due to human-grizzly bear conflicts. Section 3.15, *Recreation* discusses that all combined action alternatives would increase recreational use of the analysis area in the long term. Increased recreational activity in bear habitat may also increase human/grizzly conflicts and grizzly bear mortality.

In all combined line alternatives, food attractants would be minimized through the use of bear-resistant garbage containers, prohibiting the feeding of bears by mine employees, and the prompt removal of roadkill. Alternative 2B would include the funding by MMC of two new wildlife positions: a bear specialist and a law enforcement officer (see Chapter 2). The new bear specialist would increase public awareness of grizzly bear biology and behavior, and help to increase acceptance and support of grizzly bear management. In addition to the new positions funded by MMC, the combined agencies' alternatives would include funding for an additional bear specialist. Public attitudes are a major part of the success or failure of grizzly bear recovery efforts. It is critical to the recovery effort that people understand reasons for agency actions in order to have a favorable attitude toward grizzly bears (USFWS 1993).

The combined action alternatives could result in increased grizzly bear mortality due to increased traffic. Because roads in the operating permit areas would be closed to the public, the risk of mortality from poaching would be minimized. Although new transmission line access roads

would be gated or barriered after transmission line construction, mortality risks could increase due to improved hunter or poacher access. Mortality risks due to improved hunter or poacher access would increase more for Alternative 2B than for other combined action alternatives because more new roads would be built (Table 194). The new law enforcement position included in MMC's grizzly bear mitigation plan (see section 2.4.6.3.1, *Habitat Protection*) would help deter illegal killing of grizzly bears in the area.

Outside Recovery Zone

On National Forest System lands, none of the combined mine-transmission line alternatives would measurably change existing conditions for linear ORD, TRD, and livestock grazing. Alternative 2B would not measurably change existing availability of food attractants for the grizzly bear in the Cabinet Face BORZ. The combined agencies' alternatives would include MMC funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ polygon, reducing the availability of attractants, and reducing mortality risks for the grizzly bear in the Cabinet Face BORZ.

Assuming that some temporary housing facilities would be developed near the project site on private lands, food attractants may become more available in these areas. Alternative 2B would include the funding by MMC of a bear specialist and the combined agencies' alternatives would include funding for an additional bear specialist. Education of the public on food storage in bear habitat and increased awareness of grizzly bear behavior by the new grizzly bear specialists would help prevent human-bear conflicts.

Other potential impacts to grizzly bears in the Cabinet Face BORZ on private and state land would occur as a result of the transmission line. As shown in Table 194, the combined action alternatives would involve the construction of between about 1.5 and 3.4 miles of new access road on private land in the Cabinet Face BORZ. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. In all combined action alternatives, helicopter use during line stringing, maintenance, and inspections could result in increased disturbance to grizzly bears on private land, potentially displacing them from suitable habitat. New access road construction, helicopter use, and other construction activities would likely have minimal impacts to grizzly bears because road densities are currently high on private and state land within the alternative transmission line corridors and the area is infrequently used by grizzly bears. Public education and law enforcement efforts of the bear specialists and law enforcement officer would minimize the risk of increased grizzly bear mortality.

The clearing area for the combined action includes between 130 and 180 acres of private lands in the Cabinet Face BORZ.

On private land in the Cabinet Face BORZ, the clearing area for the combined action alternatives includes between 2 and 17 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. These effects were discussed previously under the individual effects of the transmission line alternatives.

The eastern segment of the Alternative 2B transmission line corridor would occur within the wildlife linkage zone in the Fisher River Valley. Relatively small segments of all combined action alternatives would cross the Fisher River Valley in the wildlife linkage zone. The portions of the

combined agencies' alternatives that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect grizzly bear movement in the linkage zone. A relatively small portion of alternative transmission line corridors would cross the Fisher River Valley in the wildlife linkage zone, potentially discouraging grizzly bear movement in a localized area due to transmission line construction activities. However, these effects would be short-term because human-caused disturbance would cease when the transmission line was built. Given that the area of the linkage zone potentially affected by combined action alternatives is generally heavily roaded and has been logged in the past 20 to 30 years and, given the short-term nature of human-caused disturbance, it is not likely that these alternatives would greatly affect grizzly bear movement within the linkage zone. Impacts of the combined action alternatives are described for transmission line Alternatives B, C, and D above.

Incidental Take

Alternative 2B may cause incidental take for the following reasons:

- During all phases of the proposed project, Alternative 2B would result in losses of core habitat in BMUs 5 and 6, resulting in percent core habitat worse than recommended levels in BMU 6
- During construction, Alternative 2B would increase linear ORD to worse than the standard in BMU 5
- Alternative 2B would decrease HE to worse than objectives during construction and operations in BMUs 5 and 6
- Alternative 2B would create three additional openings with points in the opening greater than 600 feet from cover

Combined agencies' alternatives may cause incidental take for the following reasons:

- All combined agencies' alternatives would result in HE worse than recommended levels during construction in BMU 5 and construction and operations in BMU 6
- All combined agencies' alternatives would create three additional openings with points in the opening greater than 600 feet from cover

Cumulative Effects

Basic road maintenance, pre-commercial thinning, mushroom picking, prescribed burning, timber hauling, wildlife habitat improvement projects, and various recreational uses have occurred and would continue to occur within the analysis area. These activities are generally not considered to have adverse impacts on the grizzly bear. These activities may incidentally affect grizzly bear use within some areas on a temporary basis, but would not likely affect the viability of this species.

Roads constructed in association with timber harvest, mining, and other development have cumulatively reduced grizzly bear HE and core areas in the analysis area. Development of private lands within the analysis area, including commercial timber harvest, land clearing, home construction, and road construction has contributed to increased disturbance of grizzly bears, loss or reduction in quality of grizzly bear habitat, and increased human-grizzly bear conflicts, all of which are expected to continue. Fire suppression has resulted in the encroachment of conifers into foraging habitat and aging of shrub habitat. As noted in section 3.17, *Social/Economics*, population growth in the area is converting areas of private land from timber or agricultural

production and open space use into residential subdivisions and ranchettes, increasing the potential for additional food attractants and human-grizzly bear conflicts.

Road status information is available for the current and reasonably foreseeable Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Rock Creek Project, and the Miller-West Fisher Vegetation Management Project. The cumulative effects of the mine and transmission line alternatives on percent core habitat, OMRD, TMRD, and linear ORD in BMUs 5 and 6 are shown in Table 196. Alternative 1A would not have cumulative impacts on the grizzly bear. None of the combined mine-transmission line alternatives or reasonably foreseeable actions would affect road status or contribute to cumulative road densities in BMU 2; cumulative effects on core and linear ORD are not displayed for BMU 2.

Inside Recovery Zone

Percent habitat effectiveness. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively decrease HE in BMUs 5 and 6, resulting in HE worse than recommended levels. Alternative 2B would decrease HE in BMU 5 more than other alternatives. In BMU 6, Alternatives 3E and 4E would contribute the most to cumulative reductions in HE. After reclamation, the combined mine-transmission line alternatives, in combination with other reasonably foreseeable actions, would improve HE relative to existing conditions.

Land acquisition programs associated with mitigation for the combined action alternatives and reasonably foreseeable actions, especially the Rock Creek Project, would reduce cumulative impacts to HE. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquisition programs included in the combined action alternatives, especially the agencies' alternatives, would minimize or eliminate decreases in HE, through road access changes and elimination of sources of grizzly bear disturbance, where possible.

Linear open road density. Except for Alternatives 3D and 4D, all of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively increase linear ORD in BMU 6 during construction, resulting in cumulative ORD worse than recommended levels. During operations, combined action alternatives would not measurably contribute to cumulative increases in linear ORD in BMU 6. Cumulatively, linear ORD in BMUs 5 and 6 would be better than existing densities after reclamation.

Open motorized route density. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively increase OMRD in BMUs 5 and 6 during operations and construction. Alternative 2B would cumulatively increase OMRD in BMUs 5 and 6 during construction more than other alternatives. Cumulative OMRD in BMUs 5 and 6 would be better than existing levels after reclamation.

Total motorized route density. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively decrease TMRD in BMU 5 during all phases of the proposed projects. Construction of the combined agencies' alternatives, in combination with other reasonably foreseeable actions, would not change TMRD in BMU 6. Alternative 2B would cumulatively increase TMRD in BMU 6 during construction and operations. All combined action alternatives, in combination with other reasonably foreseeable actions, would decrease TMRD in BMUs 5 and 6 to better than existing levels after reclamation.

Table 196. Cumulative Effects on Grizzly Bear Core Habitat, Road Densities, and Habitat Effectiveness in BMUs 2, 5, and 6 by Combined Mine-Transmission Line Alternative.[1]

Habitat Com-ponent	Existing Conditions	[1] No Action[2]	[2] MMC's Proposed Mine			[3] Agency Mitigated Poorman Impoundment Alternative									[4] Agency Mitigated Little Cherry Creek Impoundment Alternative								
			TL-B			TL-C			TL-D			TL-E			TL-C			TL-D			TL-E		
			C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R
B M U 2																							
Core %	76 (≥55 or no loss)	76/76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
OMRD %	20 (no net increase)	20/20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
TMRD %	14 (no net increase)	14/14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
HE %	79 (≥70)	79/79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
Linear ORD	0.30 (≤0.75)	0.30/.030	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
B M U 5																							
Core %	60 (≥55 or no loss)	63/64	61	61	63	66	66	68	66	66	68	66	66	68	67	67	68	67	67	68	67	67	68
OMRD %	27 (no net increase)	26/26	30	29	26	28	28	25	28	28	25	29	28	25	28	28	24	28	28	24	28	28	24
TMRD %	23 (no net increase)	19/17	22	22	17	19	19	17	20	19	17	20	19	17	19	19	17	20	19	17	20	19	17
HE %	72 (≥70)	71/73	**61**	**65**	73	**66**	**67**	74	**66**	**67**	74	**66**	**67**	74	**66**	**67**	74	**66**	**67**	74	**66**	**67**	74
Linear ORD	0.52 (≤0.75)	0.46/0.46	0.71	0.62	0.46	0.59	0.59	0.44	0.60	0.59	0.44	0.60	0.59	0.44	0.57	0.57	0.43	0.58	0.57	0.43	0.58	0.57	.43
B M U 6																							
Core %	**54** (≥55 or no loss)	54/54	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56
OMRD %	**35** (no net increase)	**37**/25	38	37	26	37	37	26	37	37	26	37	37	27	37	37	26	37	37	26	37	37	26
TMRD %	**33** (no net increase)	33/31	34	34	31	33	33	32	33	33	31	33	33	32	33	33	32	33	33	31	33	33	31
HE %	**66** (≥70)	61/73	**58**	**60**	73	**58**	**60**	73	**59**	**61**	73	**57**	**60**	72	**58**	**60**	73	**59**	**61**	73	**57**	**60**	73
Linear ORD	0.63 (≤0.75)	**0.88**/0.35	**0.91**	**0.88**	0.35	**0.89**	**0.88**	0.35	**0.88**	**0.88**	0.35	**0.90**	**0.88**	0.36	**0.89**	**0.88**	0.35	**0.88**	**0.88**	0.35	**0.90**	**0.88**	0.35

[1] The habitat parameters in this table do not reflect potential improved conditions that could result from required land acquisitions associated with mitigation for the alternatives or reasonably foreseeable actions.

[2] Effects shown are for other reasonably foreseeable actions only. Alternative 1 (No Transmission Line) would not contribute to cumulative effects on linear ORD.

Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987; USFWS (1995); IGBC (1998); and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).

For existing conditions, bolded values do not meet standards or goals. For alternatives, bolded values do not meet standards or goals and do not maintain or improve conditions for that habitat parameter. Habitat parameters that do not meet standards or goals but that are not worse than existing conditions are not bolded. Compliance with OMRD and TMRD direction is based on reclamation phase values only.

Alt. = Mine Alternative.

TL = Transmission Line Alternative.

C = Construction Phase – shown with mitigation in place as mitigation plan requires this before start of construction phase.

O = Operation Phase – includes all mitigation in place.

R = Reclamation Phase (post project) – includes all mitigation in place.

BMU = Bear Management Unit; ORD = open road density, measured in mi/mi^2; OMRD = open motorized route density; TMRD = total motorized route density; HE = habitat effectiveness.

Core areas. Cumulatively, core habitat in BMUs 5 and 6 would be better than or equal to the recommended level in all combined action alternatives during all phases of the proposed project.

Opening size. Surface impacts from reasonably foreseeable actions in BMU 5 would be minimal, and would not result in any additional openings greater than 40 acres. In BMU 6, the combined mine-transmission line alternatives would not create any new openings greater than 40 acres with points greater than 600 feet from cover, and would not contribute to cumulative increases in forest openings that bears might avoid.

Movement corridors. None of the combined alternative components or activities would contribute to cumulative impacts to linkage zones identified by Servheen *et al.* (2003). The combined action alternatives, in combination with reasonably foreseeable actions such as the Rock Creek, Miller-West Fisher, and the Libby Creek Ventures projects, could result in cumulative disruptions of bear movement along riparian corridors. If activities associated with the Miller-West Fisher Vegetation Management Project and construction of the combined action alternatives occurred concurrently, grizzly bear movement may be particularly affected in either the Miller or West Fisher creek corridors, depending on the alternative.

Seasonal components. The combined action alternatives in combination with reasonably foreseeable actions would result in cumulative disturbance to grizzly bears during the spring period. The combined action alternatives and the Rock Creek Project would occur adjacent to, and on opposite sides of, the CMW and core habitat. The Miller-West Fisher Vegetation Management Project also would occur in grizzly bear spring habitat. Due to the magnitude and duration of the cumulative disturbances, and the limited amount of foraging options available to bears in the spring, changes in spring habitat use may have adverse consequences for bear survival.

Land acquisition programs associated with mitigation for the combined action alternatives and reasonably foreseeable actions, especially the Rock Creek Project, would reduce impacts to bears in spring. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquisition programs included in the combined action alternatives, especially the agencies' alternatives, would counteract cumulative impacts to bears in spring through road access changes and elimination of sources of grizzly bear disturbance, where possible.

Mortality risk. The combined action alternatives, in combination with other reasonably foreseeable actions, could result in a cumulative increase in mortality risk due to the influx of employees and vehicles into the analysis area. The combined agencies' alternatives and the reasonably foreseeable actions would include measures to counteract the increased risk of grizzly bear mortality, such as busing employees to the project site, educating employees about the biology and behavior of grizzly bears, and equipping project sites and surrounding areas with bear-resistant garbage containers. The new law enforcement and bear specialist positions included in the combined action alternatives would help deter illegal killing of grizzly bears in the area, increase public awareness, and help to increase acceptance and support of grizzly bear management.

Outside Recovery Zone

On National Forest System lands, none of the reasonably foreseeable actions or the combined action alternatives would measurably change existing conditions for linear ORD and TMRD, livestock grazing, or food attractants for the grizzly bear in the Cabinet Face BORZ.

The combined action alternatives, in combination with reasonably foreseeable actions, could result in a cumulative increase in temporary housing facilities developed on private lands, potentially resulting in a cumulative increase in the availability of food attractants and human-grizzly bear conflicts. The bear specialists included in the combined action alternatives would help prevent human-bear conflicts by educating the public on food storage in bear habitat and increasing awareness of grizzly bear behavior.

As discussed in section 3.17, *Social/Economics*, many areas of private land are being converted from timber or agricultural production and open space use into residential subdivisions and ranchettes. The combined action alternatives, in combination with increased development of private land, could contribute to disturbance of grizzly bears on private land in the Cabinet Face BORZ. However, disturbance associated with combined action alternatives on private land in the Cabinet Face BORZ would be temporary, road densities are currently high on private and state land, and the area is infrequently used by grizzly bears. The cumulative impacts of the combined action alternatives on private land in the Cabinet Face BORZ would likely be minimal.

3.24.5.3.4 Regulatory/Forest Plan Consistency

KFP. None of the action alternatives would comply with KFP direction on threatened and endangered species that applies to the grizzly bear (KFP Vol. 1, II-1 #3 and #5, II-6, and II-22-23). All of the action alternatives would decrease HE below recommended levels during construction in BMU 5, and during construction and operations in BMU 6. All of the action alternatives would create three to four additional openings with points in the opening greater than 600 feet from cover. Additionally, Alternative 2 would not be in compliance with the KFP because it would increase linear ORD in BMU 5 to worse than the KFP standard and would result in a loss of core habitat in BMUs 5 and 6.

Endangered Species Act. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF will submit a BA to the USFWS that describes the potential effect on threatened and endangered species that may be present in the area. After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

Statement of Findings. All of the action alternatives may affect, and are likely to adversely affect, the grizzly bear.

3.24.5.4 Canada Lynx

3.24.5.4.1 Analysis Area and Methods

Canada lynx population ecology, biology, habitat description, and relationships are described in Ruggiero *et al.* (2000) and Ruediger *et al.* (2000), and is incorporated herein by reference. In addition, the final lynx listing rule (Clark 2000) provides population and habitat status on a national scale. The most recent lynx distinct population segment status is found in the BO on the effects of the Northern Rocky Mountains Lynx Amendment (USFWS 2007c). Lynx occurrence

data come from KNF historical records (NRIS Fauna), KNF data (USDA Forest Service 2005c), and other agencies (MNHP, FWP, and USFWS).

The Final EIS for the Northern Rockies Lynx Management Direction (Lynx Amendment) was completed in 2007 with the ROD signed on March 23, 2007. This decision amended the KFP by providing lynx habitat management objectives, standards, and guidelines. The decision replaces the interim application of the Lynx Conservation Assessment and Strategy (LCAS) (Ruediger *et al.* 2000). In compliance with the LCAS, the KNF delineated 47 Lynx Analysis Units (LAUs) that approximate a lynx home range size (Figure 91). The direction provided in the Lynx Amendment is applied to lynx habitat at the LAU scale. Forest wide lynx habitat was mapped in compliance with LCAS project planning standard #1; an updated map reflecting the lynx habitat terminology from the Lynx Amendment is not yet available.

The effects analysis follows the objectives, standards, and guidelines established in the Lynx Amendment. As defined in the Lynx Amendment, an objective is a "statement in a land management plan describing desired resource conditions and intended to promote achieving programmatic goals." A guideline is "a particular management action that should be used to meet an objective found in a land management plan. The rationale for deviations may be documented, but amending the plan is not required." A standard is defined as "a required action in a land management plan specifying how to achieve an objective or under what circumstances to refrain from taking action. A plan must be amended to deviate from a standard" (USFWS 2007c). In compliance with the ROD for the Lynx Amendment, only the objectives, standards, and guidelines applicable to the proposed project are analyzed, and they are only applied to lynx habitat on National Forest System lands. Those standards and guidelines considered, but found "not applicable" are found in the KNF project record. Lynx habitat in affected LAUs was estimated based on the TSMRS.

Lynx habitat connectivity is provided by an adequate amount of vegetation cover arranged in a way that allows lynx movement. Connectivity was evaluated by visually examining lynx habitat and past management activities to determine possible movement areas and potential areas where lynx travel may be hindered. Ridgelines and draws were considered high value movement areas.

The analysis area for evaluating direct effects on National Forest System land is comprised of the West Fisher (14503) and Crazy (14504) LAUs (Figure 91). To evaluate potential direct and indirect impacts of the transmission line on lynx on private and state land, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. Indirect and cumulative effects are analyzed for the West Fisher and Crazy LAUs, adjacent LAUs (for effects on habitat connectivity), and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

Analysis of Impacts to Lynx on National Forest System Lands

The objectives, standards, and guidelines developed to meet these objectives, established in the Lynx Amendment applicable to the Montanore Project, are listed below.

Objective ALL 01: Maintain or restore lynx habitat connectivity in and between LAUs and in linkage areas.

Standard ALL S1: New or expanded permanent development and vegetation management projects must maintain habitat connectivity in a LAU and/or linkage area.

Guideline ALL G1: Methods to avoid or reduce effects on lynx should be used when constructing or reconstructing highways or forest highways across federal land. Methods could include fencing, underpasses, or overpasses.

Objective VEG O1: Manage vegetation (VEG) to mimic or approximate natural succession and disturbance processes while maintaining habitat components necessary for the conservation of lynx.

Objective VEG O2: Provide a mosaic of habitat conditions through time that support dense horizontal cover and high densities of snowshoe hare. Provide winter snowshoe hare habitat in both the stand initiation structural stage and in mature, multistory conifer vegetation.

Standard VEG S1: If more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat, no additional habitat may be regenerated by vegetation management projects.

Standard VEG S2: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.

Standard VEG S6: Vegetation management projects that reduce snowshoe hare habitat in multistory mature or late successional forests may occur only:

- Within 200 feet of administrative sites, dwellings, outbuildings, recreation sites, and special use permit improvements, including infrastructure within permitted ski area boundaries
- For research studies or genetic tests evaluating genetically improved reforestation stock
- For incidental removal during salvage harvest (*e.g.*, removal due to location of skid trails)
- Exceptions 2 and 3 will only be used in LAUs where standard VEG S1 is met

Timber harvest is allowed in areas that have potential to improve winter snowshoe hare habitat but presently have poorly developed understories that lack dense horizontal cover (*e.g.*, uneven aged management systems could be used to create openings where there is little understory so that new forage can grow).

Guideline VEG G5: Habitat for alternate prey species, primarily red squirrel, should be provided in each LAU.

Guideline VEG G11: Denning habitat should be distributed in each LAU in the form of pockets of large amounts of large woody debris, either down logs or root wads, or large piles of small wind-thrown trees (“jack-strawed” piles). If denning habitat appears to be lacking in the LAU, then projects should be designed to retain some down wood, piles, or residual trees to provide denning habitat in the future.

Objective HU O1: Maintain the lynx's natural competitive advantage over other predators in deep snow, by discouraging the expansion of snow-compacting activities in lynx habit.

Objective HU O3: Concentrate activities in existing developed areas rather than developing new areas in lynx habitat.

Objective HU O5: Manage human activities, such as special uses, mineral and oil and gas exploration and development, and placement of utility transmission corridors, to reduce impacts on lynx and lynx habitat.

Guideline HU G4: For mineral and energy development sites and facilities, remote monitoring should be encouraged to reduce snow compaction.

Guideline HU G5: For mineral and energy development sites and facilities that are closed, a reclamation plan that restores lynx habitat should be developed.

Guideline HU G6: Methods to avoid or reduce effects on lynx should be used in lynx habitat when upgrading unpaved roads to maintenance levels 4 or 5, if the result would be increased traffic speeds and volumes, or a foreseeable contribution to increases in human activity or development. Maintenance levels define the level of service provided by and maintenance required for a road (FSH 7709.58, Sec 12.3 – Transportation System Maintenance Handbook). Maintenance level 4 is assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double-lane and aggregate surfaced. Some may be single-lane, and some may be paved or have dust abated. Maintenance level 5 is assigned to roads that provide a high degree of user comfort and convenience. Normally roads are double-lane and paved, but some may be aggregate surfaced with the dust abated.

Guideline HU G7: New permanent roads should not be built on ridgetops, saddles, or in areas identified as important for lynx habitat connectivity. New permanent roads and trails should be situated away from forested stringers (*i.e.*, narrow bands of forest habitat).

Guideline HU G8: Cutting brush along low-speed, low-traffic-volume roads should be done to the minimum level necessary to provide for public safety.

Guideline HU G9: On new roads built for projects, public motorized use should be restricted. Effective closures should be provided in road designs. When the project is completed, these roads should be reclaimed or decommissioned, if not needed for other management objectives.

Guideline HU G12: Winter access for non-recreation special uses and mineral and energy exploration and development, should be limited to designated routes or designated over-the snow routes.

Analysis of Impacts to Lynx on Private and State Land

Impacts to lynx on private and state land from the transmission line alternatives were evaluated qualitatively, based on KNF lynx habitat mapping for potentially affected LAUs, mapping of broad vegetation types shown on Figure 83, tracking surveys, and hair sample analyses conducted by Western Resource Development (1989f) and FWP, and predicted changes in habitat and disturbance resulting from the transmission line alternatives.

3.24.5.4.2 Affected Environment

National lynx population and habitat status descriptions are described in Clark (2000), and are incorporated by reference. The KNF is within a core lynx area identified in the recovery outline for the contiguous United States distinct population segment of the Canada lynx (USFWS 2005), and provides 1,010,000 acres of occupied lynx habitat (USDA Forest Service 2007a). At the end of 2005, all but one LAU in the KNF (14104) met the LCAS habitat standards (≥10 percent denning habitat, ≤30 percent unsuitable condition, ≤15 percent changed to unsuitable condition in 10 years) (USDA Forest Service 2006d). Due to natural wildfire events, 32 percent of the lynx habitat in LAU 14104 was in unsuitable condition. The latter two LCAS standards are also applicable under the Lynx Amendment (USDA Forest Service 2007a). The analysis area is not within proposed lynx critical habitat (73 Fed. Reg. 10862 (February 28, 2008)).

Lynx habitat in the West Fisher and Crazy LAUs was estimated based on habitat parameters described in the Lynx Amendment (Figure 91). Most historical (prior to 1997) observations of lynx or their sign in the West Fisher LAU were in the Lake Creek or West Fisher Creek drainages, although three observations were recorded near Miller Creek. At least 20 lynx observations have been recorded in the Crazy LAU, near Howard Lake and in most of the major drainages including Libby, Ramsey, and Poorman creeks. Most records of lynx in the West Fisher and Crazy LAUs are from 1985 through 1995, and none have been recorded since 1997. Table 197 displays the current lynx habitat conditions in the PSU.

Table 197. Lynx Habitat on National Forest System Lands in the West Fisher and Crazy LAUs.

LAU	Total Lynx Habitat[1] In LAU	Unsuitable Habitat[2]	Habitat Changed to Unsuitable Over Past 10 Years by Timber Management with Regeneration Harvests[3]	Number of Adjacent LAUs that Exceed 30% Lynx Habitat in an Unsuitable Condition[4]
West Fisher (14503) (acres)	20,673	727 (4)	29 (<1)	0
Crazy (14504) (acres)	31,685	1,330 (4)	193 (<1)	0

Number in parentheses is percent of total lynx habitat in LAU.
LAU = Lynx Analysis Area.
[1] Lynx habitat: suitable plus unsuitable habitat. National Forest System land only.
[2] Unsuitable habitat: habitat that currently does not provide sufficient vegetation quantity or quality (height) to be used by snowshoe hare and lynx. Generally corresponds to "lynx habitat in a stand initiation structural stage that does not provide winter snowshoe hare habitat," as described in the Lynx Amendment (USFWS 2007c). No additional regeneration harvest allowed if more than 30 percent of lynx habitat in a LAU is in a stand initiation structural stage that does not provide winter snowshoe hare habitat.
[3] Source: USDA Forest Service 2003e. No more than 15 percent of lynx habitat on National Forest System lands in a LAU may be changed by regeneration harvest in a 10-year period.
[4] Source: USDA Forest Service 2007a.

All lynx habitat components are well represented and dispersed throughout both LAUs. Only 4 percent of LAU 14503 (727 acres) and LAU 14504 (1,330 acres) consist of unsuitable habitat,

and less than 1 percent of lynx habitat has been changed to unsuitable habitat in either LAU in 10 years. In addition, none of the adjacent LAUs have more than 30 percent of lynx habitat in an unsuitable condition.

The LCAS (Ruediger *et al.* 2000) defines key linkage areas as: "habitat that provides landscape connectivity between blocks of habitat. Linkage areas occur both within and between geographic areas, where blocks of lynx habitat are separated by intervening areas of non-habitat such as basins, valleys, agricultural lands, or where lynx habitat naturally narrows between blocks." A linkage area was identified between the northern and southern end of the Cabinet Mountains (KNF Lynx Taskforce 1997; USDA Forest Service 2004). Due to the distance from the proposed project, this linkage area would not be affected by the proposed project.

Connectivity between more extensive areas of lynx habitat may be provided by narrow forested mountain ridges, shrub-steppe plateaus, wooded riparian communities, or lower elevation ponderosa pine woodlands between high elevation spruce-fir forests (Ruediger *et al.* 2000). Within West Fisher and Crazy LAUs, and within the adjacent LAUs, a large tract of lynx habitat occurs along the CMW and movement corridors and habitat connectivity appear more than adequate to support movement and dispersal of lynx.

Research on the effects of roads and trails on lynx is inconclusive, although limited information suggests that lynx do not avoid roads (McKelvey *et al.* 2000) except at high traffic volumes (Apps 2000). Snow compaction on roads or trails may facilitate access of competing carnivores that would normally be limited by snow-depths into lynx habitat (Buskirk *et al.* 2000). However, in a study conducted in western Montana, Kolbe *et al.* (2007) found that the influence of snowmobile trails on coyote movements and foraging success appeared to be minimal. Open roads occur throughout the West Fisher and Crazy LAUs; existing roads most relevant to the Montanore Project include those in major drainages such as Poorman Creek, Ramsey Creek, Libby Creek, as well as the Bear Creek Road (NFS road #278) and Libby Creek Road (NFS road #231). Roads in the Ramsey Creek, Poorman Creek, and uppermost Libby Creek drainages are currently closed to motorized traffic except winter snowmobile traffic. The current status of roads potentially affected by the Montanore Project is described in Chapter 2.

Similarly, there is little information available on the effects of human disturbance on lynx. Based on mostly anecdotal evidence, lynx appear to be generally tolerant of humans (Ruediger *et al.* 2000). The effects of human activities on lynx activity patterns and energetics are unknown (ibid.).

Habitat for red squirrels, an alternative prey species for lynx, occurs primarily in older closed-canopy forests with substantial quantities of down wood. As described in section 3.24.2, *Key Habitats*, existing levels of down wood are greater than KNF-recommended levels. Most red squirrel habitat would occur within old growth forest, although some may not meet all the criteria for old growth. As described in section 3.21, *Vegetation*, old growth in the Crazy and Silverfish PSUs, which overlap to a great extent with West Fisher and Crazy LAUs, currently meets KNF standards.

About 24 percent of LAU 14503 and about 53 percent of LAU 14504 consists of denning habitat, and most of the stands in denning habitat are generally larger than 10 acres (Figure 91). Both of these LAUs meet the standards formerly established by the LCAS for denning habitat (greater than 10 percent denning habitat). In addition, as indicated in section 3.24.2, *Key Habitats*, snags

and down wood associated with lynx denning habitat appear to be greater than KFP-recommended levels. For the alternatives analysis, potential denning habitat is considered as multistory mature or late successional forest.

Canada lynx observation data indicate that sightings have been verified in both the West Fisher and Crazy LAUs. All lynx habitat within the influence area of the Montanore Project is within these two LAUs.

Small areas of private land within the alternative transmission line corridors in the West Fisher and Crazy LAUs provide lynx habitat, specifically a parcel of Plum Creek land along West Fisher Creek, a narrow parcel of private land southeast of Howard Lake, and a parcel of private land at the confluence of Libby and Howard creeks. Other private and state land within the West Fisher and Crazy LAUs are not mapped as lynx habitat. Although lynx may occasionally venture beyond the West Fisher and Crazy LAUs, private, state, and National Forest System land in the alternative transmission line corridors does not provide suitable lynx habitat because it is too low in elevation (less than 4,000 feet), has mostly been logged, and has high road densities.

3.24.5.4.3 Environmental Consequences

Impacts to lynx habitat from individual mine and transmission line alternatives are shown in Table 198 and Table 199. None of the mine alternatives would affect lynx in LAU 14503 (West Fisher). The impacts described for mine alternatives would be limited to LAU 14504 (Crazy). The analysis area is not within proposed critical habitat for lynx (73 Fed. Reg. 10862 (February 28, 2008)), and none of the mine or transmission line alternatives would affect proposed critical habitat for lynx.

Alternative 1 – No Mine

Alternative 1 would have no impacts on lynx or lynx habitat.

Alternative 2 – MMC's Proposed Mine

ALL 01 and ALL S1: Alternative 2 would not affect any designated linkage areas. None of the Alternative 2 activities would occur along ridgelines that might serve as lynx movement areas. In Alternative 2, construction of mine facilities could affect lynx movement within LAU 14504 by removing forest cover in potential movement areas such as the Little Cherry Creek, Ramsey Creek, and Upper Libby Creek riparian corridors. New disturbance would be primarily concentrated within specific areas of these drainages, such as for the plant, adit, and impoundment sites, while direct habitat loss or alteration along most of the length of these riparian corridors would be minimal. Although traffic would increase on some mine access roads, displacement effects from human activity, including low-traffic roads, do not appear to be a major concern for lynx (Ruediger *et al.* 2000). There is no evidence that lynx avoid or are displaced by unpaved roads; therefore, unpaved roads are not considered a threat to lynx movement (USFWS 2003c). In addition, in Alternative 2, traffic volumes on National Forest System roads are anticipated to remain relatively low (see section 3.20, *Transportation*). The proposed mine would generate an additional 132 vehicles per day greater than the existing traffic volumes for Bear Creek Road, which is 120 vehicles per day for 2007. Lynx movement across roads would probably not be impeded as a result of Alternative 2, and effects on lynx movement would be minor.

Effects to wetlands and riparian areas providing potential lynx movement corridors would be minimized through implementation of MMC's proposed Wetland Mitigation Plan (see 2.4.6.1,

Wetland Mitigation Plan). In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation for Alternative 2.

Table 198. Impacts to Lynx Habitat by Mine Alternative.

Habitat Component	[1] No Mine/ Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Tailings Impoundment Alternative	[4] Agency Mitigated Little Cherry Creek Tailings Impoundment Alternative
West Fisher LAU (14503)				
LAU in Stand Initiation Structural Stage[1] (acres)	727 (4)	727 (4)	727 (4)	727 (4)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	29 (<1)	29 (<1)	29 (<1)	29 (<1)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	0 (0)	0 (0)	0 (0)
Crazy LAU (14504)				
LAU in Stand Initiation Structural Stage[1] (acres)	1,330 (4)	3,139 (10)	2,780 (9)	2,885 (9)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	193 (<1)	2,002 (4)	1,643 (3)	1,748 (4)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	391 (-2)	167 (-1)	306 (-2)

Number in parentheses is percent of all lynx habitat in LAU.
LAU = Lynx Analysis Area.
[1] Corresponds to "unsuitable" habitat as described in Ruediger *et al.* (2000). Standard: No additional regeneration harvest in stands where more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat.
[2] Standard: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.
[3] Based on mapping of lynx "denning" habitat as described in Ruediger *et al.* (2000).
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 199. Impacts to Lynx Habitat by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line/Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
West Fisher LAU (14503)					
LAU in Stand Initiation Structural Stage[1] (acres)	727 (4)	741 (4)	738 (4)	765 (4)	850 (4)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	29 (<1)	43 (<1)	40 (<1)	67 (<1)	152 (<1)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	6 (<-1)	6 (<-1)	0 (0)	5 (<-1)
Crazy LAU (14504)					
LAU in Stand Initiation Structural Stage[1] (acres)	1,330 (4)	1,433 (5)	1,398 (4)	1,400 (4)	1,400 (4)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	193 (<1)	296 (1)	261 (1)	263 (1)	263 (1)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	25 (<-1)	13 (<-1)	19 (<-1)	19 (<-1)

Number in parentheses is percent of all lynx habitat in LAU.
LAU = Lynx Analysis Area.
[1] Corresponds to "unsuitable" habitat as described in Ruediger *et al.* (2000). Standard: No additional regeneration harvest in stands where more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat.
[2] Standard: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.
[3] Based on mapping of lynx "denning" habitat as described in Ruediger *et al.* (2000).
Source: GIS analysis by ERO Resources Corp. using KNF data.

ALL G1: About 10 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Bear Creek bridge, would be chip-and-seal paved and upgraded to applicable NFS road standards. The road would be widened to 20 to 29 feet wide and designed to handle speeds of 35 to 45 mph. Of the 10 miles of Bear Creek Road that would be reconstructed for Alternative 2, about 2.5 miles occurs in lynx habitat. About 7.5 miles of realigned and new road would be needed from the Bear Creek bridge to the Ramsey Plant Site, most of which would be in lynx habitat. A single-lane bridge over Poorman Creek would be constructed to accommodate mine traffic. Public access to any portion of Bear Creek Road would not be restricted. Public access to the new mine access road would be restricted to mine-related traffic.

Reconstructed and new roads associated with Alternative 2 do not incorporate specific measures to avoid or reduce effects on lynx. Roads improved for Alternative 2 would allow higher vehicle speeds and increased traffic, and could increase the risk of lynx mortality due to vehicle collision. Lynx mortality due to vehicle collisions may be prevented or reduced by installing wildlife crossing signs or reducing speed limits on roads used for Alternative 2. Traffic volumes on National Forest System roads are anticipated to remain relatively low (see section 3.20, *Transportation*). Specific road design measures that would minimize potential road reconstruction impacts to lynx are not necessary.

VEG 01, VEG 02, and VEG S1: At mine closure, disturbed habitat would be reclaimed, potentially becoming lynx habitat in the long term. As shown in Table 198, habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) would increase from 4 to 9 percent of LAU 14504. In Alternative 2, lynx habitat would be well below the 30 percent standard. Alternative 2 would likely have minor effects on the distribution of lynx habitat components in LAU 14504.

VEG S2: In Alternative 2, about 2,002 acres of regeneration harvest, or 4 percent, would occur in lynx habitat in 10 years in LAU 14504 (Table 198). Alternative 2 would meet this standard.

VEG S6: About 391 acres of multistory or late-successional forest snowshoe hare habitat would be affected by Alternative 2 (Table 198). Alternative 2 would not meet this standard.

VEG G5 and G11: Impacts from Alternative 2 on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 307 acres of old growth would be affected by Alternative 2 (Table 145). Compared to the other mine alternatives, Alternative 2 would affect the most old growth habitat, but its effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation for Alternative 2 would likely provide additional habitat for lynx prey species. The effects of Alternative 2 on red squirrel habitat would likely be minor.

Alternative 2 would have minor effects on the proportion of multistory or mature late-successional forest associated with denning habitat in LAU 14504 (Table 198), and the standards formerly established by the LCAS for denning habitat (≥ 10 percent denning habitat) would be met. In addition, as indicated in section 3.24.2, *Key Habitats*, snags and down wood associated with lynx denning habitat appear to be greater than KFP-recommended levels.

Objectives HU 01, 03, and 05: Activities associated with Alternative 2 were designed to avoid lynx habitat and use existing roads and facilities (*i.e.*, the Libby Adit). No new snowmobile trails or play areas would be created in Alternative 2. The Ramsey Creek Road would be open yearlong to mine traffic only, but this road is currently open for administrative use and winter snowmobile use. Alternative 2 would not likely facilitate access of competing carnivores.

Guidelines HU G4 through G9 and G12: Alternative 2 includes several operational and post-operational monitoring plans (see section 2.4.5, *Operational and Post-Operational Monitoring Programs*). It would not be feasible to conduct monitoring remotely.

Alternative 2 includes a reclamation plan that over the long term would likely restore affected lynx habitat (see section 2.4.3, *Reclamation Phase*). The reclamation plan for Alternative 2 was developed with the goal of establishing a post-mining environment compatible with existing and proposed land uses, and consistent with the KFP. Disturbed areas would be recontoured where appropriate and revegetated with mostly native species. Tree and shrub seedlings would be planted in selected areas of the Ramsey Plant Site, the Libby Adit Site, and the Little Cherry Creek Tailings Impoundment Site. If reclamation were successful, disturbed areas would return to suitable lynx habitat in the long term.

As described for Guideline ALL G1 above, reconstructed and new roads associated with Alternative 2 do not incorporate specific methods to avoid or reduce effects on lynx. Alternative 2 would result in slight increases in traffic speeds and volume in LAU 14504, and could increase the risk of lynx mortality due to vehicle collisions. Lynx mortality due to vehicle collisions may be prevented or reduced by installing wildlife crossing signs or reducing speed limits on roads used for Alternative 2. Traffic volumes on KNF roads are anticipated to remain relatively low (see section 3.20, *Transportation*). Specific road design measures that would minimize potential road reconstruction impacts to lynx are probably not necessary.

All new roads associated with Alternative 2 except for the reconstructed segments of the Bear Creek Road would be gated and restricted to public access. All new roads would be decommissioned following mine closure. Winter road access for activities associated with Alternative 2 would be limited to designated routes. Alternative 2, as well as the other mine alternatives, would include plowing of the Bear Creek Road (NFS road #278), and the Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, which would make access to lynx habitat easier for trappers and increase the risk of incidental lynx mortality.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to lynx in LAU 14504 from Alternative 3 would be the same as Alternative 2, with the exception of the following.

ALL 01 and ALL S1: Impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan (sections 2.5.7.1, *Wetland Mitigation* and 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D). Potential impacts to lynx movement within the LAU also would be minimized by concentrating disturbance from plant facilities and adits in Libby Creek.

VEG 01, VEG 02, and VEG S1: Although habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) would increase from 4 to 9 percent of LAU 14504 (Table 198), lynx habitat would be well below the 30 percent standard threshold. Alternative 3 would likely have minor effects on the distribution of lynx habitat components in LAU 14504.

VEG S2: In Alternative 3, about 1,643 acres of regeneration harvest, or 3 percent of all lynx habitat in LAU 14504, would occur in lynx habitat in 10 years (Table 198). Alternative 3 would meet this standard.

VEG S6: About 167 acres of multistory or late-successional forest snowshoe hare habitat would be impacted by Alternative 3 in LAU 14504 (Table 198). Alternative 3 would not meet this standard.

VEG G5 and G11: Impacts from Alternative 3 on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 183 acres of old growth would be impacted by Alternative 3, but the effects on the proportion of old growth in the analysis area would be small. Red squirrel habitat would continue to be available at close to existing levels in Alternative 3.

HU 01, 03, and 05: Activities associated with Alternative 3 were designed to avoid lynx habitat and use existing roads and facilities (*i.e.*, the Libby Adits and Upper Libby Adit). Potential impacts to lynx movement within the LAU also would be minimized by concentrating disturbance from plant facilities and adits in the Libby Creek drainage.

For Alternative 3, disturbed areas would be reseeded with native species only, except in specific situations as approved by lead agencies. Also, reclamation success criteria and planting/seeding conditions would be more rigorous, and tree planting densities would be greater in Alternative 3 than Alternative 2. These modifications in the reclamation plan would likely result in more rapid revegetation of lynx habitat.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to lynx in LAU 14504 from Alternative 4 would be the same as Alternative 3, with the exception of the following.

VEG S2: In Alternative 4, about 1,748 acres of regeneration harvest, or 6 percent, would occur in lynx habitat in LAU 14504 in 10 years (Table 198). Alternative 4 would meet this standard.

VEG S6: About 306 acres of multistory or late-successional forest snowshoe hare habitat would be impacted by Alternative 4 (Table 198). Alternative 4 would not meet this standard.

VEG G5 and G11: Impacts from Alternative 4 on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 175 acres of old growth would be impacted by Alternative 4, but the effects on the proportion of old growth in the analysis area would be small. Red squirrel habitat would continue to be available at close to existing levels in Alternative 4.

Alternative A – No Transmission Line

Alternative A would not affect the lynx or lynx habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Effects on Lynx on National Forest System Lands

ALL 01 and ALL S1: Alternative B would not affect any designated linkage areas.

In Alternative B, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller, Howard, Libby, and Ramsey creek corridors. Vegetation would be cleared in areas of ground disturbance, such as access roads and pulling and tensioning sites. In some portions of transmission line clearing areas, only the tallest trees would be removed, leaving some shrub and tree cover in the transmission line right-of-way. Portions of the clearing area would not require clearing, such as high spans across valleys. Areas of surface disturbance in lynx habitat would return to suitable lynx habitat in the long term. The greatest regeneration harvest would occur with Alternative B, compared to the other transmission line alternatives. Regeneration harvest would occur on up to 14 acres of lynx habitat in LAU 14503, and up to 103 acres of lynx habitat in LAU 14504. Displacement effects from human activity, including low-traffic roads, do not appear to be a major concern for lynx (Ruediger *et al.* 2000). Construction activities and transmission line access roads would probably not affect lynx movement within LAUs 14503 and 14504.

Implementation of MMC's proposed Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*) and the Environmental Specifications (Appendix D) would promote connectivity by increasing availability of continuous forest or shrub cover. In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative B would potentially improve lynx habitat connectivity, if it were managed to provide lynx habitat.

ALL G1: Reconstructed and new roads associated with Alternative B do not incorporate specific measures to avoid or reduce effects on lynx. Alternative B would include the construction of new roads and reconstruction of existing roads for transmission line access. Use of most of these roads would be limited to construction equipment during the construction period, and traffic volumes would be low. Specific measures that would minimize potential impacts to lynx are not necessary.

VEG 01, VEG 02, and VEG S1: Following construction, land within the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. After the transmission line has been built, roads opened or constructed for transmission line access would be gated or barriered and regraded, scarified, and reseeded as an interim reclamation activity designed to stabilize the surface. After the transmission line was removed, all newly constructed roads would be bladed and recontoured to match existing topography, obliterating the road prism. Disturbed habitat would potentially return to suitable lynx habitat in the long term. As shown in Table 199, although habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) would increase from 4 to 5 percent of LAU 14504, lynx habitat would be well below the 30 percent standard threshold. Impacts from Alternative B in LAU 14503 would not change the proportion of habitat in a stand initiation structural stage (*i.e.*, unsuitable condition). Alternative B would likely have minor effects on the distribution of lynx habitat components in either LAU.

VEG S2: In Alternative B, about 43 acres and 296 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively. The effects of Alternative B on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative B would meet this standard.

VEG S6: Alternative B would affect about 6 acres of multistory or late-successional forest snowshoe hare habitat in LAU 14503, and 25 acres in LAU 14504. Alternative B would not meet this standard. Compared to other transmission line alternatives, impacts on multistory or late-successional forest snowshoe hare habitat would be the greatest for Alternative B.

VEG G5 and G11: Impacts from Alternative B on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 23 acres of old growth would be affected by Alternative B. Compared to the other transmission line alternatives, Alternative B would affect the most old growth habitat, but its effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative B would potentially provide additional habitat for lynx prey species, if it was managed to provide lynx habitat. The impacts of Alternative B on red squirrel habitat would likely be minor.

Alternative B would have minor effects on the overall proportion of multistory or mature late-successional forest associated with denning habitat in LAUs 14503 and 14504 (Table 199), and the standards formerly established by the LCAS for denning habitat (≥10 percent denning habitat) would be met. As indicated in section 3.24.2, *Key Habitats*, snags and down wood associated with lynx denning habitat appear to be greater than KFP-recommended levels in the analysis area. Some shrub and tree cover would be maintained in the transmission line right-of-way; only the largest trees would be removed and some areas would not be cleared, providing down wood important for lynx denning.

HU 01, 03, and 05: No new snowmobile trails or play areas would be created in Alternative B. Components of Alternative B were designed, to the extent possible, to avoid lynx habitat and use existing roads and facilities. Where possible, roads currently open year-round would be used for construction access. Although some new access roads would be built, and some currently closed roads would be opened for transmission line access, these roads would be used temporarily during transmission line construction and would not likely be used during winter.

HU G4 through G9 and G12: Alternative B includes several operational and post-operational monitoring plans (see section 2.5.5, *Reclamation Phase*). It would not be feasible to conduct monitoring remotely.

Alternative B includes a reclamation plan that over the long term would likely restore affected lynx habitat (see section 2.8.3, Operation, Maintenance, and Reclamation). The reclamation plan for Alternative B was developed with the goal of establishing a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Following construction, land within the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. Access roads opened or constructed for transmission line access would be gated or barriered and regraded, scarified, and reseeded after transmission line construction. At mine closure, the transmission line would be removed and all new roads would be recontoured and reclaimed, obliterating the road prism. Native shrubs, such as alder or willow, would be planted on streambanks to reduce bank erosion.

As described for Guideline ALL G1 above, reconstructed and new roads associated with Alternative B do not incorporate specific methods to avoid or reduce effects on lynx. Traffic volumes on KNF roads are anticipated to remain relatively low (see section 3.20, *Transportation*).

Specific measures that would minimize potential road reconstruction impacts to lynx are probably not necessary.

Winter road access for activities associated with Alternative B would be limited to designated routes. Access roads opened or constructed for transmission line access would be used only during the construction phase or for maintenance, which is expected to be required infrequently, and would not likely be used during winter. Annual inspections and most transmission line maintenance would be completed via helicopter or non-motorized access.

Effects on Lynx on Private and State Land

Alternative B would affect about 1 acre of land in LAUs 14504 and 14503, which provide lynx habitat at the confluence of Libby and Howard creeks. Effects to lynx on other private lands would be minimal because those lands do not provide suitable lynx habitat. Effects to lynx habitat would be reduced through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative B would potentially improve lynx habitat, if managed to provide lynx habitat.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative C would be the same as Alternative B, with the exception of the following:

ALL 01 and ALL S1: More right-of-way and tree clearing, but fewer structures and access roads, would be required for Alternative C than Alternative B. In Alternative C, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller Creek and Howard Creek riparian corridors. Regeneration harvest would occur on up to 11 acres of lynx habitat in LAU 14503, and up to 68 acres of lynx habitat in LAU 14504. The least regeneration harvest would occur with Alternative C, compared to the other transmission line alternatives. These acreages are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan developed for Alternative C (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize tree clearing, thereby maintaining more shrub and tree cover in the transmission line right-of-way than Alternative B. Slash would be left in the right-of-way, providing down wood important for lynx denning. Areas of surface disturbance in lynx habitat, such as access roads and pulling and tensioning sites, would return to suitable lynx habitat in the long term if reclamation were successful.

Implementation of the agencies' Wetland Mitigation Plan (section 2.5.7.1, *Wetland Mitigation*), Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D) would promote connectivity by increasing availability of continuous forest or shrub cover. In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative C would potentially improve lynx habitat connectivity, if it were managed to provide lynx habitat.

VEG 01, VEG 02, and VEG S1: As shown in Table 199, the percent of habitat in LAUs 14503 and 14504 in a stand initiation structural stage (*i.e.*, unsuitable condition) would not change in Alternative C. Alternative C would likely have minor effects on the distribution of lynx habitat components in either LAU.

VEG S2: In Alternative C, about 40 acres and 261 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively (Table 199). These calculations are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*) developed for the agencies' alternatives would minimize tree clearing. The effects of Alternative C on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative C would meet this standard.

VEG S6: Impacts from Alternative C on multistory or late-successional forest snowshoe hare habitat would consist of about 6 acres in LAU 14503 and 13 acres in LAU 14504 (Table 199). Alternative C would not meet this standard. Implementation of the Vegetation Removal and Disposition Plan developed for Alternative C (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize these impacts. Slash would be left in the right-of-way, providing down wood important for lynx denning. Compared to other transmission line alternatives, impacts on multistory or late-successional forest snowshoe hare habitat would be the least for Alternative C and Alternative D.

VEG G5 and G11: Impacts from Alternative C on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 8 acres of old growth would be impacted by Alternative C. Compared to the other transmission line alternatives, Alternative C would affect the least old growth habitat, and its effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative C would potentially provide additional habitat for lynx prey species, if it were managed to provide lynx habitat. Red squirrel habitat would continue to be available at close to existing levels in Alternative C.

Alternative C would have minor effects on the overall proportion of multistory or mature late-successional forest associated with denning habitat in LAUs 14503 and 14504 (Table 199), and the standards formerly established by the LCAS for denning habitat (≥10 percent denning habitat) would be met. As indicated in section 3.24.2, *Key Habitats*, snags and down wood associated with lynx denning habitat appear to be better than KFP-recommended levels in the analysis area. Some shrub and tree cover would be maintained in the transmission line right-of-way, and areas would not be cleared, providing coarse down wood important for lynx denning. Also, slash and large logs would be left in the right-of-way, providing down wood important for lynx denning.

HU 01, 03, and 05: No new snowmobile trails or play areas would be created in Alternative C. Components of Alternative C were designed, to the extent possible, to avoid lynx habitat and use existing roads and facilities. Fewer structures and access roads would be required for Alternative C than Alternative B. For Alternative C, helicopters would be used to construct structures at 20 locations in the Miller Creek, Midas Creek, and Howard Creek drainages, thereby eliminating the need for access roads in these locations.

Effects on Lynx on Private and State Land

Alternative C would affect about 1 acre of private land in LAUs 14504 and 14503, which provide lynx habitat at the confluence of Libby and Howard creeks. Impacts to lynx on other private lands would be minimal because they do not provide suitable lynx habitat. Effects of mitigation would be the same as Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative D would be the same as Alternative C, except the following.

In Alternative D, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller Creek and Howard Creek corridors. Regeneration harvest would occur on 67 acres of lynx habitat in LAU 14503, and 263 acres of lynx habitat in LAU 14504.

VEG S2: In Alternative D, about 67 acres and 263 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively (Table 199). These acreages are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan developed for agencies' alternatives (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize tree clearing. The effects of Alternative D on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative D would meet this standard.

VEG S6: No multistory or late-successional forest snowshoe hare habitat would be affected by Alternative D in LAU 14503. Impacts from Alternative D on multistory or late-successional forest snowshoe hare habitat would consist of about 19 acres in LAU 14504 (Table 199). Alternative D would not meet this standard. Implementation of the Vegetation Removal and Disposition Plan developed for Alternative D (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize these impacts. Compared to other transmission line alternatives, Alternative C and Alternative D would have the least effect on multistory or late-successional forest snowshoe hare habitat.

VEG G5 and G11: Impacts from Alternative D on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 13 acres of old growth would be impacted by Alternative D. Compared to the other transmission line alternatives, Alternative D would affect the least old growth habitat, and its effects on the proportion of old growth in the analysis area would be minor.

HU 01, 03, and 05: For Alternative D, helicopters would be used to construct structures at 21 locations in the Miller Creek and Howard Creek drainages, thereby eliminating the need for access roads in these locations.

Effects on Lynx on Private and State Land

Effects on lynx on private land in LAUs 14504 and 14503 would be the same for Alternative D as Alternative C. Alternative D would affect about 4 acres of a narrow parcel of private land southeast of Howard Lake mapped as unsuitable lynx habitat.

Alternative E – West Fisher Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative E would be the same as Alternative C, with the exception of the following.

VEG S2: In Alternative E, about 152 acres and 263 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively (Table 199). These acreages are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan developed for the agencies' alternatives (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize tree clearing. The effects of Alternative E on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative E would meet this standard.

VEG S6: Impacts from Alternative E on multistory or late-successional forest snowshoe hare habitat would consist of about 5 acres in LAU 14503 and 19 acres in LAU 14504 (Table 199). Alternative E does not meet this standard. Implementation of the Vegetation Removal and Disposition Plan developed for Alternative E (section 2.5.3.2.1, *Vegetation Removal and Disposition*) would minimize these impacts.

VEG G5 and G11: Impacts from Alternative E on old growth forest potentially providing red squirrel habitat are described in section 3.21, *Vegetation*. About 13 acres of old growth would be impacted by Alternative E. Compared to the other transmission line alternatives, Alternative E would affect the least old growth habitat, and the effects on the proportion of old growth in the analysis area would be minor.

HU 01, 03, and 05: For Alternative E, helicopters would be used to construct structures at 21 locations along West Fisher Creek, thereby eliminating the need for access roads in these locations.

Effects on Lynx on Private and State Land

Alternative E would affect about 30 acres of land in LAUs 14504 and 14503 providing lynx habitat on a parcel of Plum Creek land along West Fisher Creek. Alternative E would affect about 4 acres of a narrow parcel of private land southeast of Howard Lake mapped as unsuitable lynx habitat. Effects to lynx on other private lands would be minimal because those lands do not provide suitable lynx habitat.

Combined Mine-Transmission Line Effects

Impacts to lynx habitat from combined mine-transmission line alternatives are shown below in Table 200 and summarized in the following paragraphs.

Effects on Lynx on National Forest System Lands

The No Action Alternative would not affect lynx or their habitat. The mine alternatives would not affect lynx in LAU 14503. Impacts in LAU 14503 are due entirely to the effects of the transmission line.

ALL 01 and ALL S1: None of the combined mine-transmission line alternatives would affect any designated linkage areas.

Table 200. Impacts to Lynx Habitat by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine/ Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Cherry Creek Impoundment Area		
	TL-A	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
West Fisher LAU (14503)								
LAU in Stand Initiation Structural Stage[1] (acres)	727 (4)	741 (4)	738 (4)	765 (4)	850 (4)	738 (4)	765 (4)	850 (4)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	29 (<1)	43 (<1)	40 (<1)	67 (<1)	152 (<1)	40 (<1)	67 (<1)	152 (<1)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	6 (<-1)	6 (<-1)	0 (0)	5 (<-1)	6 (<-1)	0 (0)	5 (<-1)
Crazy LAU (14504)								
LAU in Stand Initiation Structural Stage[1] (acres)	1,330 (4)	3,228 (10)	2,896 (9)	2,895 (9)	2,895 (9)	3,064 (10)	2,997 (9)	2,997 (9)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	193 (<1)	2,088 (7)	1,708 (5)	1,710 (5)	1,710 (5)	1,874 (6)	1,814 (6)	1,814 (6)
Impacts to Multi-story Mature or Late Succession Forest Snowshoe Hare Habitat[3] (acres)	0 (0)	425 (-3)	186 (-1)	193 (-1)	193 (-1)	345 (-2)	335 (-2)	335 (-2)

Number in parentheses is percent of all lynx habitat in LAU.
LAU = Lynx Analysis Area.
[1] Corresponds to "unsuitable" habitat as described in Ruediger *et al.* (2000). Standard: No additional regeneration harvest in stands where more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat.
[2] Standard: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.
[3] Based on mapping of "denning" habitat as described in Ruediger *et al.* (2000).
Source: GIS analysis by ERO Resources Corp. using KNF data.

In all combined action alternatives, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas in the Miller, Howard, Libby, West Fisher, and Ramsey creek corridors. Vegetation would be cleared in areas of ground disturbance, such as access roads and pulling and tensioning sites. In some portions of transmission line clearing areas only the largest trees would be removed, leaving some shrub and tree cover in the transmission line right-of-way. Portions of the clearing area would not require clearing, such as high spans across valleys. Areas of surface disturbance in lynx habitat could be restored to suitable lynx habitat in the long term if natural successional processes were permitted to occur. Displacement effects from human activity, including low-traffic roads, do not appear to be a major concern for lynx (Ruediger *et al.* 2000). Construction activities and transmission line access roads would probably not affect lynx movement within LAUs 14503 and 14504.

Implementation of MMC's proposed Wetland Mitigation Plan (see section 2.4.6.1, *Wetland Mitigation Plan*), the agencies' Wetland Mitigation Plan (section 2.5.7.1, *Wetland Mitigation*), Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*), and the Environmental Specifications (Appendix D) would promote connectivity by increasing availability of continuous forest or shrub cover. In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of the combined action alternatives would potentially improve lynx habitat connectivity, if it were managed to provide lynx habitat.

ALL G1: Reconstructed and new roads associated with all combined action alternatives do not incorporate specific measures to avoid or reduce effects on lynx. All combined action alternatives would include the construction of new roads and reconstruction of existing roads for transmission line access. Use of most of these roads would be limited to construction equipment during the construction period, and traffic volumes would be low. Specific measures that would minimize potential impacts to lynx are not necessary.

VEG 01, VEG 02, and VEG S1: In all combined action alternatives, following construction, land within the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. After the transmission line has been built, roads opened or constructed for transmission line access would be gated or barriered and regraded, scarified, and reseeded as an interim reclamation activity designed to stabilize the surface. After the transmission line was removed, all newly constructed roads would be bladed and recontoured to match existing topography, obliterating the road prism. Disturbed habitat would potentially return to suitable lynx habitat in the long term. As shown in Table 200, habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) in LAU 14504 would increase by 6 percent for Alternatives 2B and 4C, and by 5 percent in all other combined action alternatives. However, habitat in a stand initiation structural stage would be less than the 30 percent standard. None of the combined action alternatives would change the proportion of habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) in LAU 14503. All combined action alternatives would likely have minor effects on the distribution of lynx habitat components in either LAU.

VEG S2: All combined action alternatives would increase regeneration harvest occurring in lynx habitat in 10 years in LAUs 14503 and 14504, but the proportion of regeneration harvest in lynx habitat in 10 years would be less than the 10 percent standard.

VEG S6: All combined action alternatives would affect multistory or late-successional forest snowshoe hare habitat. Impacts to multistory or late-successional forest snowshoe hare habitat in LAU 14503 would be between 5 and 6 acres for all combined action alternatives except Alternatives 3D and 4D, which would not affect multistory or late-successional forest snowshoe hare habitat in LAU 14503. Impacts to multistory or late-successional forest snowshoe hare habitat in LAU 14504 would be between 186 and 193 acres for Alternatives 3C, 3D, 3E; between 335 and 345 acres for Alternatives 4C, 4D, and 4E; and 425 acres for Alternative 2B. None of the combined action alternatives would meet this standard.

VEG G5 and G11: As described in section 3.21, *Vegetation*, all combined action alternatives would affect old growth forest potentially providing red squirrel habitat. Impacts to old growth would range from 185 acres for Alternatives 4C and 4E to 325 acres for Alternative 2B, but the effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of the combined action alternatives would potentially provide additional habitat for lynx prey species, if it were managed to provide lynx habitat. The impacts of the combined action alternatives on red squirrel habitat would likely be minor.

All combined action alternatives would have minor effects on the overall proportion of multistory or mature late-successional forest associated with denning habitat in LAUs 14503 and 14504 (Table 200), and the standards formerly established by the LCAS for denning habitat (≥10 percent denning habitat) would be met in all combined mine-transmission line alternatives.

HU 01, 03, and 05: No new snowmobile trails or play areas would be created for any of the combined mine-transmission line alternatives. Components of combined action alternatives were designed, to the extent possible, to avoid lynx habitat and to use existing roads and facilities. Where possible, roads currently open year-round would be used for construction access. Although some new access roads would be built and some currently closed roads would be opened for transmission line access, these roads would be used temporarily during transmission line construction and would not likely be used during winter.

HU G4 through G9 and G12: Combined action alternatives include several operational and post-operational monitoring plans (see sections 2.5.6, *Operational and Post-Operational Monitoring Programs* and 2.6.6, *Mitigation Plans*). It would not be feasible to conduct monitoring remotely.

All combined action alternatives include a reclamation plan that over the long term would return disturbed lynx habitat to pre-project quality. Reclamation plans have been discussed previously.

As described for Guideline ALL G1 above, reconstructed and new roads associated with the combined action alternatives do not incorporate specific methods to avoid or reduce effects on lynx. Traffic volumes on KNF roads are anticipated to remain relatively low (see section 3.20, *Transportation*). Specific measures that would minimize potential road reconstruction impacts to lynx are probably not necessary.

Winter road access for activities associated with the combined action alternatives would be limited to designated routes. Access roads opened or constructed for transmission line access would be used only during the construction phase or for maintenance, which is expected to be required infrequently, and would not likely be used during winter. Annual inspections and most transmission line maintenance would be completed via helicopter or non-motorized access. However, all combined

action alternatives would include plowing of the Bear Creek Road (NFS road # 278), and the Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, which would make access to lynx habitat easier for trappers and increase the risk of incidental lynx mortality.

Tranmission Line Effects on Lynx on Private and State Land

Impacts of the combined action alternatives to lynx habitat on private lands in LAUs 14504 and 14503 would occur at the following locations:

- All combined action alternatives would affect 22 acres of suitable lynx habitat from development of the Libby Adit
- Alternatives 2B, 3C, 3D, 4C, and 4D would affect about 1 acre of suitable lynx habitat at the confluence of Libby and Howard creeks
- Alternatives 3D, 3E, 4D, and 4E would affect about 4 acres of unsuitable lynx habitat southeast of Howard Lake
- Alternative 4E would affect about 30 acres of lynx habitat on a parcel of Plum Creek land along West Fisher Creek

Other private and state land potentially affected by the combined action alternatives within LAUs 14503 and 14504 are not mapped as lynx habitat. Impacts to lynx on private and state lands outside of LAUs 14503 and 14504 would be minimal because they do not provide suitable lynx habitat.

Cumulative Effects

Effects on Lynx on National Forest System Lands

Neither Alternative 1 nor Alternative A would have cumulative impacts on lynx. The mine action alternatives would not have any impacts to lynx in LAU 14503, and would not contribute to cumulative impacts in this LAU.

Basic road maintenance, pre-commercial thinning, mushroom picking, prescribed burning, timber hauling, wildlife habitat improvement projects and various recreational uses have occurred and would continue to occur within the analysis area. These activities are generally not considered to have adverse impacts on wildlife species. These activities may incidentally affect wildlife use within some areas on a temporary basis, but would not likely affect the viability of lynx.

ALL 01 and ALL S1: None of the combined mine-transmission line alternatives would contribute to cumulative impacts to any designated linkage areas. Cumulative effects of both mine and transmission line alternatives, in combination with other ongoing or reasonably foreseeable actions, on lynx movement within LAU 14504 would be minor. Lynx movement does not appear to be affected by low-traffic roads, and areas of reduced cover would be small relative to surrounding habitat. The combined effects of the removal of forest cover in potential movement areas associated with the combined action alternatives and the Miller-West Fisher Vegetation Management Project could result in cumulative effects to lynx movement in LAU 14503.

ALL G1: All combined action alternatives, in combination with reasonably foreseeable actions, would result in slight increases in traffic speeds and volume in LAUs 14503 and 14504, thereby increasing the risk of lynx mortality due to vehicle collisions. For the transmission line alternatives, cumulative traffic increases would occur primarily during the construction period and would be short-

term. Cumulative traffic increases for the mine alternatives would be long-term and would last through the reclamation phase. Vehicle collisions could be prevented or reduced by installing wildlife crossing signs or reducing speed limits on roads used for the Montanore Project. Cumulative traffic volumes are anticipated to be low (see section 3.20, *Transportation*). Specific measures that would minimize potential impacts to lynx would not be necessary for any of the action alternatives.

VEG 01, VEG 02, and VEG S1: Habitat in a stand initiation structural stage (*i.e.*, unsuitable condition) would remain less than 10 percent for combined mine-transmission line alternatives. The combined mine-transmission line alternatives, in combination with other ongoing or reasonably foreseeable actions, would not likely exceed the 30 percent standard.

VEG S2: Regeneration occurring in 10 years would remain less than 7 percent in LAUs 14503 and 14504 in all combined mine-transmission line alternatives. The combined mine-transmission line alternatives, in combination with other ongoing or reasonably foreseeable actions, would not likely exceed the 15 percent standard.

VEG S6: All combined action alternatives, in combination with other ongoing or reasonably foreseeable actions, would affect multistory or late-successional forest snowshoe hare habitat. The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU, which encompasses LAU 14503. It is not possible to quantify the effects on multistory or late-successional forest snowshoe hare habitat from other reasonably foreseeable projects, but the Miller-West Fisher and road access projects in particular are likely to add to impacts to multistory or late-successional forest snowshoe hare habitat.

VEG G5 and G11: The combined mine-transmission line alternatives, in combination with the Miller-West Fisher Vegetation Management Project would maintain the designated management level of old growth (see section 3.21, *Vegetation*). It is likely that the designated management level of old growth would continue to be maintained despite the cumulative effects of the combined action alternatives and ongoing or reasonably foreseeable actions. Thus, the action alternatives would not likely substantially reduce red squirrel habitat in LAU 14503 or 14504.

In all combined action alternatives, denning habitat would be at least 14 and 40 percent greater in LAUs 14503 and 14504, respectively, than the standard formerly established by the LCAS for denning habitat (≥ 10 percent denning habitat). This standard would likely be met when the effects of other ongoing or reasonably foreseeable actions are included. Also, activities associated with the Miller-West Fisher Vegetation Management Project are expected to retain down wood within KFP guideline levels for the Silverfish PSU, and while prescribed burns associated with the Miller-West Fisher Vegetation Management Project would consume some down wood, it also would create down wood by killing live trees. Down wood created in burned areas would provide lynx denning habitat and habitat for alternative prey species such as red squirrels. Cumulative impacts from the action alternatives would not likely cause a shortage of snags and down wood associated with lynx denning habitat, given the current levels.

HU 01, 03, and 05: New winter road use would be minimal for the mine alternatives, and would be limited to a few new access roads within permit boundaries. Transmission line access roads would rarely be used during the winter. All combined action alternatives would include plowing of the Bear Creek Road (NFS road #278), and the Libby Creek Road (NFS road #231) during the evaluation program and while the Bear Creek Road is reconstructed, which would make access to lynx habitat

easier for trappers and increase the risk of incidental lynx mortality. Minor levels of additional winter road use could occur for other ongoing and reasonably foreseeable actions. Cumulatively, expansion of snow-compacting activities and increased winter access for trappers is expected to be minimal in all action alternatives.

In all combined action alternatives, traffic volumes and speeds may cumulatively be greater in the Miller Creek and West Fisher Creek drainages and near main access roads (see section 3.20, *Transportation*), resulting in an increased risk of lynx mortality from vehicle collisions. Cumulative traffic increases in LAU 14503 would occur primarily during transmission line construction and would be short-term. Cumulative traffic increases from the mine alternatives in LAU 14504 would be long-term and would last through the reclamation phase, although traffic increases would be lower during reclamation than operations. Vehicle collisions could be prevented or reduced by installing wildlife crossing signs or reducing speed limits on roads used for the Montanore Project. Cumulative traffic volumes are not anticipated to be high enough to warrant incorporation of specific road design measures to minimize potential impacts to lynx.

Tranmission Line Effects on Lynx on Private and State Land

The combined action alternatives, in combination with reasonably foreseeable actions, could result in a cumulative increase in temporary housing facilities developed on private lands, potentially resulting in cumulative impacts to lynx habitat in LAUs 14504 and 14503. Also, as discussed in section 3.17, *Social/Economics*, many areas of private land are being converted from timber or agricultural production and open space use into residential subdivisions and ranchettes. Development of private land would likely occur primarily outside of LAUs 14504 and 14503, but some could occur within suitable lynx habitat in those LAUs. Impacts of the combined action alternatives, in combination with increased development of private land, could result in cumulative losses of lynx habitat on private land, but these losses would probably be minor, given the likely extent of impacts and quality of habitat potentially impacted.

3.24.5.4.4 Regulatory/Forest Plan Consistency

KFP. All of the combined mine-transmission line alternatives comply with KFP direction on threatened and endangered species that applies to the lynx (KFP Vol. 1, II-1 #7 and II-22).

Endangered Species Act. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF will submit a BA to the USFWS that describes the potential effect on threatened and endangered species that may be present in the area. After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

Statement of Findings. All of the combined action alternatives would likely adversely affect the Canada lynx because they would affect multistory or late-successional forest snowshoe hare habitat. None of the combined mine-transmission line alternatives would likely result in the destruction or adverse modification of proposed critical habitat.

3.24.5.5 Irreversible and Irretrievable Commitments

No irreversible commitments of resources due to impacts on the Canada lynx or their habitat would occur as a result of any of the action alternatives.

Due to the length of the proposed activity (25 to 30 years), the loss of available habitat, and reduced habitat effectiveness, the habitat carrying capacity for grizzly bear would be reduced in all combined

action alternatives. This effect may be irreversible should the loss of 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. 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, based on a high probability of reduced species diversity. This habitat loss could reduce the carrying capacity to the point that a viable population of grizzly bears could not be supported.

Irretrievable commitments of resources would occur as a result of impacts to lynx from the combined action alternatives, including the loss of multistory or late-successional forest snowshoe hare habitat and non-compliance with standard VEG S6. The combined action alternatives also would result in an increase in unsuitable lynx habitat and the loss of old growth forest potentially providing red squirrel habitat.

3.24.5.6 Short-term Uses and Long-term Productivity

For the mine alternatives, impacts to the grizzly bear, including the loss of available habitat and reduced habitat effectiveness, would last until mine reclamation was completed. New openings in forest cover would remain in the long term, but could return to their former condition after a considerable period of time. For the transmission line alternatives, most of the impacts to grizzly bear would subside once the transmission line and substation were built, until decommissioning. Short-term impacts to grizzly bear from the transmission line include a reduction in forest cover and an increase in open grass or shrub fields.

Long-term losses of lynx habitat would occur in all combined action alternatives, including the loss of multistory or late-successional forest snowshoe hare habitat. Although small relative to the amount of existing habitat, the greatest habitat losses would occur at the impoundment sites, followed by the plant and adit sites. If reclamation were successful, areas of disturbed lynx habitat could potentially be restored to suitable lynx habitat, but only after a considerable length of time. New roads constructed for transmission line access would be redisturbed during removal of the transmission line at reclamation. Although redisturbed transmission line access roads would be revegetated, recovery of lynx habitat would be prolonged in redisturbed areas.

3.24.5.7 Unavoidable Adverse Environmental Effects

Unavoidable adverse effects would occur to the grizzly bear due to the construction of new roads, the opening of closed roads, and mine and transmission line construction activities and operations. Unavoidable impacts to lynx would occur due to losses or alteration of lynx habitat from the construction of mine and transmission line facilities.

3.24.6 Migratory Birds

3.24.6.1 Regulatory Framework

Migratory birds, including raptors, their eggs, and any active nests, are protected under the MBTA. The MBTA stipulates that it is unlawful to destroy an active migratory bird nest, nestling, or eggs. For most migratory bird species, the active nesting season is generally April through August.

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, requires analysis of effects of federal actions on migratory birds as part of the environmental analysis process.

On January 17, 2001, the USDA Forest Service and the USFWS signed an MOU to implement the Executive Order.

Under NFMA guidelines, Forest Plans shall "provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives…" (16 USC 1604(g)(3)(B)). Additional direction states that "management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which could be expected in a natural forest." Furthermore, implementation regulations for the NFMA specify that, "fish and wildlife habitat shall be managed to maintain diverse populations of existing native and desired non-native vertebrate species in the planning area."

The MFSA directs DEQ to approve a facility if, in conjunction with other findings, DEQ finds and determines that the facility minimizes adverse environmental impacts, considering the state of available technology and the nature and economics of all of the alternatives. An assessment of effects on birds is part of the transmission line certification process.

3.24.6.2 Analysis Area and Methods

Information regarding species occurrence comes from District wildlife observation records, and KNF historical data, MNHP, and the results of bird surveys conducted in 1989 and 2005 (Western Resource Development 1989f; Westech 2005a). Impacts to migratory birds are evaluated based on alternative effects on habitat associated with bird communities observed, as described in section 3.21, *Vegetation*; MIS species representing specific habitats; bird species discussed in section 3.24.4, *Forest-Sensitive Species*; and mortality risks. The analysis area for project impacts and cumulative effects to individuals and their habitat consists of the Crazy and Silverfish PSUs and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. The analysis area for cumulative effects is the KNF and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

3.24.6.3 Affected Environment

In Montana, most non-grouse (Order *Gallinaceous*) birds, except for European starling, house sparrow, and rock dove (pigeon), are protected under the MBTA, even though species such as the great horned owl tend to be present throughout the year. Most migratory birds are species that migrate to more northerly latitudes to breed during the summer. By the fall, these species migrate south to spend the winter months. Of the 205 bird species known to occur on the KNF, about 70 species could be classified as neotropical migratory land birds, or birds that migrate annually to and from the tropics in Mexico or Latin America.

The area surveyed by Western Resource Development (1989f) and Westech (2005a) included the permit areas and road corridors for Alternative 2, and the transmission line corridor for Alternative B. A complete list of birds observed during existing studies of the analysis area are provided in Western Resource Development (1989f) and Westech (2005a). Similar species were recorded during both studies. Species observed were expected for the particular habitats surveyed. Western Resource Development (1989f) found that the number of bird species was greatest in riparian habitat, followed by shrubfield habitat. Studies conducted by Westech (2005a) yielded somewhat different results; the number of species observed was greatest in shrubfield habitat. Differences between the two studies in

the number of species observed were likely due to differences in sampling methods and intensity (Westech 2005a).

Sections 3.24.4, *Forest-Sensitive Species* and 3.24.7, *Other Species of Interest* include a description of existing conditions for the black-backed woodpecker, flammulated owl, and goshawk. MIS species represent the habitat needs for migratory birds in general forest, old growth, and alpine habitat. As habitat for MIS species is being maintained, it is assumed that sufficient habitat and populations of migratory birds is also being maintained. Existing conditions for birds breeding in general forest, alpine, and old growth habitats are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.24.3, *Management Indicator Species*.

3.24.6.4 Environmental Consequences

3.24.6.4.1 Alternative 1 – No Mine

Alternative 1 would have no impacts on migratory birds.

3.24.6.4.2 Alternative 2 – MMC's Proposed Mine

Based on impacts described in section 3.21, *Vegetation*, birds associated with coniferous forest would be the most affected by Alternative 2, followed by birds associated with previously harvested coniferous forest. About 72 acres of riparian and wetland areas providing potential habitat for birds would be affected by Alternative 2. All wetlands affected would be replaced with wetlands with similar functions and values. Alternative 2 would affect more coniferous forest community, regeneration harvest community, and riparian areas than the other alternatives. At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, this would probably take decades or even centuries.

Impacts of Alternative 2 on the black-backed woodpecker, flammulated owl, and northern goshawk are described in sections 3.24.4, *Forest-Sensitive Species* and 3.24.7, *Other Species of Interest*. Alternative 2 impacts on general forest, alpine, and old growth habitats providing potential habitat for breeding birds are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.24.3, *Management Indicator Species*.

Response of migratory birds to timber harvest would depend upon their individual habitat preferences and needs. Clearing for mine facilities would remove forest habitat used by some species (*e.g.*, brown creeper, golden-crowned kinglet, Townsend's warbler, and Swainson's thrush) and shrub field habitat used by other species (*e.g.*, orange-crowned warbler, yellow warbler, and spotted towhee). Mine disturbance areas would likely provide little or no habitat for migratory birds. In addition, clearing would eliminate old growth habitat and snags, reducing densities of migratory birds dependent on those habitat features. While Alternative 2 would result in localized impacts to birds associated with forest and shrub field habitats, it would not result in widespread changes in bird communities on the KNF.

Vegetation clearing and earth moving during construction of Alternative 2 facilities could result in the destruction of active nests or eggs, or nest abandonment, if conducted during the migratory bird breeding season.

3.24.6.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to migratory birds from Alternative 3 would be the similar to Alternative 2, except that birds associated with previously coniferous forest would be the most affected by Alternative 3, followed by

birds associated with coniferous forest. Alternative 3 would affect less riparian and wetland areas providing potential habitat for birds (about 5 acres). All wetlands affected would be replaced with wetlands with similar functions and values. In comparison to Alternative 2, Alternative 3 would result in 571 fewer acres of habitat loss because the tailings impoundment would be smaller and the plant site would be located in the same drainage as the adits (Table 141). Also, as described in the agencies' Wildlife Mitigation Plan (section 2.5.7.3, *Wildlife Mitigation*), Alternative 3 includes timing restrictions and pre-construction nest surveys for black-backed woodpeckers, flammulated owls, and northern goshawks that would minimize the risk of nest destruction or abandonment for these species. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species. These measures would reduce potential impacts to both migratory and non-migratory birds.

3.24.6.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to migratory birds from Alternative 4 would be similar to Alternative 2, except that less coniferous forest and more previously harvest coniferous forest would be affected. Alternative 4 would affect less riparian and wetland areas providing potential habitat for birds (about 58 acres). In comparison to Alternative 2, Alternative 4 would result in 328 fewer acres of habitat loss because the plant site would be located in the same drainage as the adits (Table 141). Implementation of the agencies' Wildlife Mitigation Plan (section 2.5.7.3, *Wildlife Mitigation*) would be the same as Alternative 3, and would similarly reduce potential impacts to both migratory and non-migratory birds.

3.24.6.4.5 Alternative A – No Transmission Line

Alternative A would have no impacts on migratory bird habitat.

3.24.6.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Based on impacts described in section 3.21, *Vegetation*, Alternative B would affect the smallest amount of vegetation providing bird habitat compared to the other transmission line alternatives because of a narrower tree clearing width (150 feet compared to 200 feet) (Figure 83). As described in section 3.21, *Vegetation*, although more new roads would be built for Alternative B than other transmission line alternatives, direct impacts of road construction on vegetation communities would be relatively minor. Total disturbance from roads associated with Alternative B would be 14 acres. Birds associated with coniferous forest would be most affected by Alternative B, followed by birds associated with regeneration harvest areas. The transmission line clearing area would include about 13 acres of riparian and wetland areas providing potential habitat for birds. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Alternative B would affect more coniferous forest community, regeneration harvest community, and riparian areas than the other alternatives. At the end of operations, disturbed habitat would be revegetated. Roads would be redisturbed for transmission line decommissioning and reclaimed after transmission line removal. After reclamation, disturbed habitat would potentially be restored to pre-transmission line conditions in the long term. For forested habitat, this would take probably take decades or even centuries.

Impacts of Alternative B on the bald eagle, black-backed woodpecker, flammulated owl, and northern goshawk are described in sections 3.24.4, *Forest-Sensitive Species* and 3.24.7, *Other Species of Interest*. Alternative B impacts on general forest, alpine, and old growth habitats providing potential habitat for breeding birds are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.24.3, *Management Indicator Species*.

Response of migratory birds to timber harvest depends upon their individual habitat preferences and needs. Clearing of forested areas for the transmission line would remove forest habitat used by some species (*e.g.*, brown creeper, golden-crowned kinglet, Townsend's warbler, and Swainson's thrush) and create grassland and shrubland habitat used by other bird species (*e.g.*, American kestrel, calliope hummingbird, and chipping sparrow). Clearing also would create edge habitat used by birds such as the dark-eyed junco, red-tailed hawk, and great-horned owl. While Alternative B would result in localized changes in species composition, it would not result in widespread changes in bird communities on the KNF.

Vegetation clearing and earth moving during construction of the transmission line could result in the destruction of active nests or eggs if conducted during the migratory bird breeding season. The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

The likelihood of the 230-kV transmission line resulting in the electrocution of migratory species including raptors is extremely low; electrocution is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and the Environmental Specifications (Appendix D).

The proximity of the Alternative B transmission line to the Fisher River could increase the risk of bird collisions with the transmission line. Potential collisions of migratory birds with the transmission line would be reduced by constructing the transmission line according to recommendations outlined in APLIC (1994) and in compliance with the Environmental Specifications (Appendix D). Applicable recommendations include locating the transmission line away from streams, mountain passes, and other potential flight corridors; placement of the lines below treeline or other topographical features; and installation of line marking devices. The latter recommendation would be particularly relevant where the transmission line crossed the Fisher River.

3.24.6.4.7 Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts to migratory birds from Alternative C would be similar to Alternative B, except that more habitat would be disturbed due to a wider clearing width, and the transmission line clearing area would include less riparian and wetland areas that provide potential habitat for birds (about 5 acres). Also, the risk of bird collisions with the transmission line would be less for Alternative C because it also would be from the Fisher River corridor. In addition, as specified in section 2.9.4, *Wildlife Mitigation Measures*, areas of high risk for bird collisions where line marking devices may be needed (*i.e.*, major drainage crossings) and recommendations for the type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC. The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

3.24.6.4.8 Alternative D – Miller Creek Transmission Line Alternative

Impacts to migratory birds from Alternative D would be similar to Alternative C, except that more habitat would be disturbed due to the longer length of Alternative D, and the transmission line

clearing area would include more riparian and wetland areas providing potential habitat for birds (about 14 acres). The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

3.24.6.4.9 Alternative E – West Fisher Creek Transmission Line Alternative

Impacts to migratory birds from Alternative E would be similar to Alternatives C and D, except that more habitat would be disturbed due to the longer length of Alternative E. The transmission line clearing area in Alternative E would include more riparian and wetland areas (about 29 acres) providing potential habitat for birds than Alternative C (about 5 acres), and Alternative D (about 14 acres). The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

3.24.6.4.10 Combined Mine-Transmission Line Effects

Impacts to vegetation communities providing potential migratory bird habitat for combined mine and transmission line alternatives are shown in Table 201 and described below.

Table 201. Impacts to Potential Migratory Bird Habitat by Combined Mine-Transmission Line Alternative.

Vegetation Community	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Cherry Creek Impoundment Area		
	TL-A	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Coniferous Forest (acres)	0	1,709	1,139	1,152	1,091	1,262	1,275	1,214
Previously Harvested Coniferous Forest (acres)	0	1,054	1,190	1,184	1,244	1,257	1,251	1,311
Wetland/Riparian (acres)	0	84	10	19	34	63	72	87

Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Based on vegetation community impacts (Table 201), Alternative 2B would have the greatest impacts on birds associated with coniferous forest, affecting 1,709 acres. Birds associated with previously harvested coniferous forest would be most affected by Alternatives 3E, 4C, 4D, and 4E. Impacts to riparian and wetland areas providing potential habitat for birds would range from 10 acres for Alternative 3C to 87 acres for Alternative 4E. At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat such as old growth, this could take centuries. At the end of operations, disturbed habitat would be revegetated. Roads would be redisturbed for transmission line decommissioning and reclaimed after transmission line removal. After reclamation, disturbed habitat would potentially be restored to pre-transmission line conditions in the long term.

Response of migratory birds to timber harvest depends upon their individual habitat preferences and needs. Clearing of forested areas for mine facilities and transmission lines would remove forest cover used by some species (*e.g.*, brown creeper, golden-crowned kinglet, and hermit thrush) and create grassland and shrubland habitat used by other bird species (*e.g.*, American kestrel, calliope hummingbird, and chipping sparrow). Clearing also would create edge habitat used by birds such as the dark-eyed junco, western tanager, and Townsend's warbler. While all combined action alternatives would result in localized changes in species composition, they would not result in widespread changes in bird communities on the KNF.

Impacts of the combined action alternatives on the bald eagle black-backed woodpecker, flammulated owl, and northern goshawk are described in sections 3.24.4, *Forest-Sensitive Species* and 3.24.7, *Other Species of Interest*. Combined action alternatives impacts on general forest, alpine, and old growth habitats providing potential habitat for breeding birds are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.24.3, *Management Indicator Species*.

In all combined action alternatives, as specified in the Environmental Specifications (Appendix D) and the agencies' Wildlife Mitigation Plan (sections 2.5.7.3, *Wildlife Mitigation* and 2.9.4, *Wildlife Mitigation Measures*), either tree removal would not occur during the breeding season for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks, or surveys would be conducted in potential habitat for these species prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks. Alternative 2B does not include timing restrictions or sensitive species surveys of the mine disturbance area.

3.24.6.4.11 Cumulative Effects

Cumulative impacts of the action alternatives on the bald eagle, black-backed woodpecker, flammulated owl, and northern goshawk are described in sections 3.24.4, *Forest-Sensitive Species* and 3.24.7, *Other Species of Interest*. Cumulative impacts of the combined mine-transmission line alternatives impacts on general forest, alpine, and old growth habitats providing potential habitat for breeding birds are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.24.3, *Management Indicator Species*.

The transmission line alternatives, in combination with other reasonably foreseeable actions, would result in cumulative changes in species composition resulting from the conversion of forests to an early successional stage or to grasslands and shrubland. These cumulative habitat changes would favor migratory birds associated with grassland or shrubland habitats, and could contribute to a shift in species composition on the KNF.

3.24.6.4.12 Regulatory/Forest Plan Consistency

There are no specific goals or standards for migratory land birds in the KFP. One of the goals in the KFP is to: "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species (KFP, Vol. 1, II-1 #7)." All action alternatives are consistent with the KFP because a wide range of successional habitats would be available (see sections 3.21, *Vegetation* and 3.24.3, *Management Indicator Species*). The action alternatives are in compliance with Executive Order 13186. In addition, because habitat for MIS species is being maintained in the Crazy and Silverfish PSUs and across the KNF, their habitat contributes to the maintenance of habitat and populations of neotropical migratory bird species.

3.24.6.5 Irreversible and Irretrievable Commitments

All action alternatives would result in an irreversible commitment of old growth and cavity habitat provided by snags and down wood in the analysis area. Re-establishment of old growth communities could take centuries.

All action alternatives would result in the loss of or disturbance to habitat supporting migratory birds. Following successful reclamation, with the exception of old growth communities, most disturbed habitats and their associated bird communities would eventually be restored to pre-mine or pre-transmission line conditions.

3.24.6.6 Short-term Uses and Long-term Productivity

Disturbed areas would be reclaimed at the end of mine operations or transmission line operations. If reclamation were successful, most habitats affected by the action alternatives would return to pre-mine or pre-transmission line conditions after several decades. Once habitat was restored, associated bird communities would likely return.

3.24.6.7 Unavoidable Adverse Environmental Effects

Unavoidable adverse environmental effects would occur where vegetation was cleared for mine facilities, roads, or the transmission line.

3.24.7 Other Species of Interest

3.24.7.1 Regulatory Framework

The KFP (KFP Vol. 1, II-1 # 3 and #7, II-7; and II-22-23) provides guidance for moose management concerning motorized access and maintenance of old growth and other age classes of vegetation.

Under NFMA guidelines, Forest Plans shall “provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives…” (16 USC 1604(g)(3)(B)). Additional direction states that “management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which could be expected in a natural forest.”

The MFSA directs DEQ to approve a facility if, in conjunction with other findings, DEQ finds and determines that the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the alternatives. An assessment of effects on moose winter range and state species of concern is part of the transmission line certification process. In addition, FWP has also expressed concerns about potential impacts of the Montanore Project on moose.

3.24.7.2 Moose

3.24.7.2.1 Analysis Area and Methods

The analysis area for evaluating direct and indirect project impacts to individual moose and their habitat in the KNF is the Crazy and Silverfish PSUs (Figure 92). The analysis areas for determining direct, indirect, and cumulative effects on moose are the FWP moose HD number 105 and the KNF, respectively. To evaluate potential direct and indirect impacts of the transmission line on moose on private and state land, the analysis area includes all non-National Forest System land within a corridor

1 mile on each side of the alternative transmission line alignments. The Crazy and Silverfish PSUs and any land within a corridor 1 mile on each side of the alternative transmission line alignments is the analysis area for cumulative effects on moose.

Moose occurrence data come from District wildlife observation records, Forest historical data (NRIS FAUNA), and other agencies (MNHP, FWP). Moose winter range was derived from FWP and Western Resource Development (1989f) mapping and modified based on KNF and FWP biologists' knowledge of moose habitat use. Because their habitat requirements are similar, the same criteria used to evaluate project impacts on elk in the KNF were used for moose, with the following exceptions:

- Direct impacts to mapped moose winter range were calculated
- Cover to forage ratios were calculated for moose winter range, based on the mapping described above
- The recommended cover-to-forage ratio in moose winter range is 50 percent cover to 50 percent forage habitat
- The recommended proportion of cover in MAs 15, 16, and 17 is 30 percent, which is the same as white-tailed deer (MA designations, goals, and standards are described in detail in section 3.14.3.2.2, *Management Area Goals and Standards*)
- Similar to white-tailed deer, the number of openings greater than 20 acres was evaluated
- Movement areas evaluated were the same as white-tailed deer

MMC's proposed Alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the yearlong access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include yearlong access changes, through the installation of barriers or gates, for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD, habitat effectiveness and security calculations. Additional road access changes also would occur on land acquired as part of the grizzly bear mitigation proposed by MMC and the agencies. ORD calculations do not take into account the effect of land acquisition programs proposed by MMC and the agencies described in the respective mitigation plans in sections 2.4.6.3, *Grizzly Bear Mitigation Plan* and 2.5.7.3, *Wildlife Mitigation*. Other mitigation measures incorporated into MMC's or the agencies' alternatives that could benefit moose include construction timing restrictions in moose winter habitat, prohibiting employees from carrying firearms, busing employees to the work site, and monitoring road-killed animals along mine access roads to determine if improved access resulted in increased wildlife mortality.

Impacts to moose on private and state land from the transmission line corridor were evaluated based on FWP-derived winter habitat mapping (Figure 92); security habitat generated from KNF roads data; FWP hunting and population data, research, and plans; KNF and FWP information on wildlife linkage areas; and mapping of broad vegetation types shown on Figure 83.

3.24.7.2.2 Affected Environment

The moose is a large ungulate that occupies mountain meadows, river valleys, swampy areas, and clearcuts in the summer; and willow flats or mature coniferous forests in the winter. Due to their large size and long limbs, moose negotiate deep snow better than other ungulates. Conifer stands composed

of uneven-aged classes and willows are important components of cover for moose (FWP and MNHP 2007).

Moose use riparian habitat throughout the year along the various creeks in the analysis area. They also use drier mid-elevation areas during summer. Their food consists primarily of shrubs, with some forbs during summer. In the analysis area, moose concentrate along riparian areas, in 15- to 20-year-old clearcuts with shrubby understories, in shrubfields, and in forested areas with shrubby understories. Moose prefer to live well up the Libby Creek and Ramsey creek drainages, as well as the other drainages along the east face of the Cabinet Mountains. They move out of these areas to the east and down the drainages only when forced to do so by increasing snowpack. They return to the upper portions of these drainages as early in the late winter/early spring as snow hardness allows. During some years, they remain high in the drainages into late January and early February. Moose could be expected to occupy areas around proposed impoundment and plant sites for 8 to 10 months of the year, depending on winter severity (Brown, pers. comm. 2008).

The area near Little Cherry Creek and Bear Creek is a very productive moose calving area in HD 105 (Williams, pers. comm. 2006). During late fall and winter, moose concentrate along Little Cherry Creek, Poorman Creek, Ramsey Creek, Miller Creek, West Fisher Creek, and on Big Hoodoo Mountain and west-facing slopes above the Fisher River (Figure 92) (Brown, pers. comm. 2008).

HD 105 is one of seven hunting districts in Region 1 selected by FWP for long-term moose population trend monitoring, based on its importance to moose. A standard “trend route” along the east slope of the Cabinet Mountains in HD 105 is surveyed annually to collect moose population composition and trend monitoring data (FWP 2007b). Trends in population, size, and composition are evaluated based on total moose, calf/cow ratios, and bull/cow ratios observed during trend area surveys. Harvest data and hunter effort data for HD 105 are also taken into consideration in the evaluation of population trends (Brown, pers. comm. 2008). Based on trend area data collected since 1990 and harvest data collected since 1984, the moose population in HD 105 showed a decline in overall numbers and recruitment in the mid-1990s. Since that time, moose populations in HD 105 have generally been increasing, although numbers of moose observed during 2007 surveys were lower than average (FWP 2007c). Results of the 2007 surveys could have been affected by poor weather conditions. During moose surveys of HD 105 conducted in December 2007, moose were observed in the highest concentrations on south- and west-facing slopes of the Little Hoodoo and Big Hoodoo mountains in the Big Cherry Creek and Bear Creek drainages, and on west-facing slopes of the Libby Creek drainage near Horse Mountain (ibid.).

As described for elk in section 3.24.3, *Management Indicator Species*, a wildlife linkage zone has been identified in the Fisher River Valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2, and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (see KNF project records). U.S. 2 in the Fisher River Valley between Raven and Brulee creeks is a crossing area for moose moving between the Cabinet Mountains and the Salish Mountains (Brown, pers. comm. 2008).

3.24.7.2.3 Environmental Consequences

Impacts to moose winter range and percent cover in moose winter range in the Crazy and Silverfish PSUs are shown in Table 202 and Table 203 and described in the following subsections. None of the mine alternatives would affect moose in the Silverfish PSU. Impacts on percent cover in summer range and MAs 15, 16, and 17; movement areas; road densities; percent security habitat, habitat effectiveness, and the creation of new openings would be the same as white-tailed deer in the Crazy PSU, and the same as elk in the Silverfish PSU. Impacts to white-tailed deer and elk are described in

section 3.24.3, *Management Indicator Species*. Habitat effectiveness and security were not determined for elk in the Crazy PSU, but are shown in Table 205 for combined mine-transmission line alternatives.

Table 202. Impacts to Moose Winter Range in the Crazy PSU by Mine Alternative.

Habitat Component	[1] No Mine/ Existing Conditions	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Tailings Impoundment Alternative	[4] Agency Mitigated Little Cherry Creek Tailings Impoundment Alternative
Moose Winter Range Impacted (acres)	0	2,417	1,904	2,079
Cover in Winter Range Impacted (acres)	0	2,011	1,710	1,702
Percent Cover/Forage Moose Winter Range[1]	90/10 (50/50)	80/20	82/18	82/18

Values in parentheses represent standards.
[1] Percent forage habitat is likely underestimated because moose will forage in shrubfields that may be mapped as cover.
Source: GIS analysis by ERO Resources Corp. using KNF data and moose winter range derived from FWP and Western Resource Development 1989f mapping as modified based on KNF and FWP biologists' knowledge of moose habitat use.

Alternative 1 – No Mine

Alternative 1 would have no impacts on moose or their habitat.

Alternative 2 – MMC's Proposed Mine

Alternative 2 would result in the disturbance of 2,417 acres of moose winter habitat, mostly as a result of the tailings impoundment and the LAD Areas (Table 202). This loss of habitat also would include key calving habitat. Cover to forage ratios would shift due to clearing of cover, but cleared areas would not provide forage habitat until after they were reclaimed. Alternative 2 would likely result in the displacement of moose to adjacent winter range and calving sites. Moose may occupy a home range of a few hundred acres during the winter, and certain individuals could be completely or partially displaced from their traditional wintering sites. If moose populations in surrounding areas subsequently exceed carrying capacity as a result of this habitat loss, the moose population may be adversely affected. Widening, improvement, and yearlong access of the Bear Creek Road could lead to increased vehicle volumes and speed, which could increase the risk of moose mortality from vehicle collisions. Impacts to moose winter range would be at least partially minimized through MMC's proposed land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve or contribute suitable moose winter habitat if the acquired parcels potentially provided winter range characteristics and were managed to improve winter moose habitat through road access changes or other means.

Table 203. Impacts to Moose Winter Range in the Analysis Area by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line/ Existing Conditions	[B] MMC's Proposed Transmission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Transmission Line Alternative	[D] Miller Creek Transmission Line Alternative	[E] West Fisher Creek Transmission Line Alternative
Crazy PSU					
Cover in Winter Range Impacted (acres)	0	41	29	15	15
Percent Cover/Forage Moose Winter Range[1]	90/10 (50/50)	80/10	80/10	80/10	80/10
Silverfish PSU					
Cover in Winter Range Impacted (acres)	0	60	76	71	100
Percent Cover/Forage Moose Winter Range[1]	97/3 (50/50)	97/3	97/3	97/3	96/4
All Lands in Analysis Area					
Moose Winter Range Impacted (acres)	0	146	165	168	210

Numbers in parentheses are standards.
[1] Percent forage habitat is likely underestimated because moose will forage in shrubfields that may be mapped as cover.
Source: GIS analysis by ERO Resources Corp. using KNF data and moose winter range derived from FWP and Western Resource Development 1989f mapping as modified based on KNF and FWP biologists' knowledge of moose habitat use.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Impacts to moose from Alternative 3 would be similar to Alternative 2, except that less moose winter range and calving habitat would be impacted. In Alternative 3, about 1,904 acres of moose winter range would be impacted, mostly as a result of the tailings impoundment and LAD Areas (Table 202). Alternative 3 would include more road access changes and more habitat acquisition, and would more effectively minimize potential effects on moose. In addition, in Alternative 3 wildlife mortality due to vehicle collisions would be monitored. If, in consultation with the FWP, wildlife mortality from road-killed animals were found to be excessive, mitigation measures would be developed to reduce mortality risks.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to moose from Alternative 4 would be similar to Alternatives 2 and 3, except that less moose winter range and calving habitat would be affected. In Alternative 4, about 2,079 acres of moose winter range would be affected, mostly as a result of the tailings impoundment (Table 202).

Alternative A – No Transmission Line

Alternative A would have no impacts on moose habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

For Alternative B, some winter range would be disturbed in both the Crazy and Silverfish PSUs, but not enough to change the cover-to-forage ratio. About 41 acres of winter range would be disturbed in the Crazy PSU, while about 60 acres of winter range would be disturbed in the Silverfish PSU (Table 203). All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. If revegetation were successful, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving moose habitat conditions in the Silverfish PSU toward KFP objectives. Impacts to moose would be minimized through application of construction timing restrictions in moose winter range. After the transmission line was removed, all newly constructed roads would be redisturbed during blading and contouring, before being seeded. Impacts to moose winter range would be at least partially minimized through MMC's proposed land acquisition program. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve or contribute suitable moose winter habitat if the acquired parcels potentially provided winter range characteristics and were managed to improve winter moose habitat. Current populations of moose would likely be maintained in Alternative B, despite the habitat disturbance.

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife linkage zone in the Fisher River Valley. Impacts of Alternative B on moose in the wildlife linkage zone would be the same as described for elk in section 3.24.3, *Management Indicator Species*.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Impacts of Alternative C on moose would be similar to Alternative B, except that slightly less moose winter range would be disturbed in the Crazy PSU and slightly more moose winter range would be affected in the Silverfish PSU. Alternative C would include more road access changes and more habitat acquisition, and would more effectively minimize potential effects on moose. Also, impacts to moose also would be minimized through application of construction timing restrictions in moose winter range.

A relatively small portion of the Alternative C transmission line would cross the Fisher River Valley in the wildlife linkage zone, potentially discouraging moose movement in a localized area due to transmission line construction activities. Impacts of Alternative C on moose in the wildlife linkage zone would be the same as described for elk in section 3.24.3, *Management Indicator Species*.

Alternative D – Miller Creek Transmission Line Alternative

Impacts of Alternative D would be similar to Alternative C, except that slightly less moose winter range would be impacted in the Crazy and Silverfish PSUs. Impacts of Alternative D on moose in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Alternative E – West Fisher Creek Transmission Line Alternative

Impacts of Alternative E would be similar to Alternative C, except that slightly less moose winter range would be impacted in the Crazy PSU, while slightly more moose winter range would be impacted in the Silverfish PSU.

Impacts of Alternative E on moose in the wildlife linkage zone in the Fisher River Valley would be the same as Alternative C.

Combined Mine-Transmission Line Effects

Impacts to moose winter range and percent cover in moose winter range in the analysis area are shown in Table 204. Impacts to percent security habitat and percent habitat effectiveness in the Crazy and Silverfish PSUs are shown in Table 205. Combined impacts on percent cover in summer range and MAs 15, 16 and 17; movement areas; road densities; and the creation of new openings would be the same as white-tailed deer in the Crazy PSU, and the same as elk in the Silverfish PSU. Impacts to white-tailed deer and elk are described in section 3.24.3, *Management Indicator Species*.

Table 204. Impacts to Moose Winter Range in the Analysis Area by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Cherry Creek Impoundment Area		
	TL-A	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Crazy PSU								
Cover in Winter Range Impacted (acres)	0	2,052	1,739	1,725	1,725	1,731	1,717	1,717
Percent Cover/forage Moose Winter Range[1]	90/10 (50/50)	80/20	82/18	82/18	82/18	82/1/	82/18	82/18
Silverfish PSU								
Cover in Winter Range Impacted (acres)	0	100	60	76	71	100	76	71
Percent Cover/forage Moose Winter Range[1]	97/3 (50/50)	97/3	97/3	97/3	96/4	97/3	97/3	96/4
All Lands in Analysis Area								
Moose Winter Range Impacted (acres)	0	2,696	2,223	2,228	2,313	2,507	2,404	2,489

Numbers in parentheses represent KFP standards or desired conditions.
Impacts shown are for the transmission line construction phase, which represents maximum estimated impacts.
[1] Percent forage habitat is likely underestimated because moose will forage in shrubfields that may be mapped as cover.
Source: GIS analysis by ERO Resources Corp. using KNF data and moose winter range derived from FWP and Western Resource Development 1989f mapping as modified based on KNF and FWP biologists' knowledge of moose habitat use.

Alternative 2B would affect the most moose winter range of all combined mine-transmission line alternatives, resulting in impacts to 2,696 acres, while Alternative 3C would impact the least moose winter range, impacting 2,223 acres. Most impacts to moose winter range from the combined action alternatives would result in losses of moose habitat within the disturbance areas for the impoundment sites and LAD Areas, and would likely result in the displacement of moose to adjacent winter range and calving sites. In all combined action alternatives, cover-to-forage ratios would shift due to clearing of cover, but areas cleared for the mine components would not provide forage habitat until after they were reclaimed. In all combined action alternatives, areas disturbed for transmission line construction would be seeded with grass and shrub species after transmission line construction and could provide additional forage habitat as forage species become established.

Table 205. Percent Moose Security Habitat, Habitat Effectiveness, and Open Road Densities in the Crazy and Silverfish PSUs by Combined Mine-Transmission Line Alternative.

Measurement Criteria	[1] No Mine Existing Condition	[2] MMC's Proposed Mine		[3] Agency Mitigated Poorman Impoundment Alternative						[4] Agency Mitigated Little Cherry Creek Impoundment Alternative					
		TL-B		TL-C		TL-D		TL-E		TL-C		TL-D		TL-E	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Crazy PSU															
Percent Security Habitat[3]	40 (>30)	36	36	40	40	40	40	40	40	40	40	40	40	40	40
Habitat Effectiveness[4]	53 (>68)	49	50	52	52	52	53	52	52	52	52	52	52	52	52
Silverfish PSU															
Percent Security Habitat[3]	57 (>30)	55	57	55	57	57	57	57	57	55	57	57	57	57	57
Habitat Effectiveness[4]	76 (>68)	74	76	74	76	76	76	74	76	74	76	76	76	74	76

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during mine construction.
[2] Ops = during transmission line operations.
[3] Security habitat is calculated by buffering all roads open during the fall (October 15 to November 30) by 0.5 mile. The remaining area equals the effective habitat. No security habitat occurs on private or state land in the analysis area.
[4] Habitat effectiveness is calculated by buffering all roads open during the summer period (July 1 to October 14) by 0.25 mile. The remaining area within the PSU equals the effective habitat.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative 2B includes an access change in NFS road #4724 from April 1 to June 30 to mitigate for impacts to grizzly bears and the agencies' alternatives would include access changes (installation of barriers or gates and public access changes) for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These access changes are taken into account in security, habitat effectiveness, and ORD calculations.

Alternative 2B would reduce the percent security habitat in the Crazy PSU by 4 percent during construction and operations, although it would still be greater than KFP-recommended levels. Due to access changes associated with mitigation, none of the combined agencies' alternatives would affect percent security habitat in the Crazy PSU. Alternatives 2B, 3C, and 4C would result in 2 percent reduction in moose security habitat in the Silverfish PSU during transmission line construction. Percent security habitat would return to existing levels following transmission line construction. Alternatives 3D, 3E, 4D, and 4E would not change percent security habitat in the Silverfish PSU.

Overall, Alternative 2B would affect habitat effectiveness the most. Alternative 2B would decrease habitat effectiveness in the Crazy PSU by 4 percent during construction and 3 percent during operations. With the exception of Alternative 3D, the combined agencies' alternatives would decrease habitat effectiveness in the Crazy PSU by 1 percent during construction and operations. In Alternative 3D, habitat effectiveness in the Crazy PSU would return to existing levels during operations. Alternatives 2B, 3C, 3E, 4C, and 4E would result in a 2 percent decrease in habitat effectiveness in the Silverfish PSU during construction. Following transmission line construction, habitat effectiveness would return to existing levels for these alternatives. None of the other combined action alternatives would affect habitat effectiveness in the Silverfish PSU.

All combined action alternatives would likely result in the displacement of moose to adjacent winter range and calving sites. If moose populations in surrounding areas subsequently exceed carrying capacity as a result of this habitat loss, the moose population may be adversely affected. Widening and improvement of the Bear Creek Road, and winter snowplowing of plant access and haul roads could lead to increased vehicle volumes and speeds, and an increase in moose use of these roads as travel routes, which could increase the risk of moose mortality from vehicle collisions.

The eastern segment of the Alternative 2B transmission line corridor would occur within the wildlife linkage zone in the Fisher River Valley. Relatively small segments of all combined action alternatives would cross the Fisher River Valley in the wildlife linkage zone. The portions of the combined agencies' alternative transmission lines that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect moose movement in the linkage zone. Impacts of the combined mine-transmission line alternatives on moose in the Fisher River Valley wildlife linkage zone are the same as described for elk in section 3.24.3, *Management Indicator Species*.

For all combined action alternatives, impacts to moose winter range during transmission line construction would be minimized through the application of construction timing restrictions. Winter range impacts also would be at least partially minimized through MMC and the agencies' land acquisition programs. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve or contribute suitable moose winter habitat if the acquired parcels potentially provided winter range characteristics and were managed to improve winter moose habitat. Of the 50 parcels identified as potential replacement habitat for mitigating the effects of the proposed project, 21 may provide moose habitat. The agencies' Wildlife Mitigation Plan (section 2.5.7.3, *Wildlife Mitigation*) would include more road access changes and more habitat acquisition, and would more effectively minimize potential effects on moose. For combined agencies' alternatives, busing employees to the

work site would reduce the risk of moose mortality from vehicle collisions. For the combined agencies' alternatives, wildlife mortality due to vehicle collisions would be monitored. If, in consultation with the FWP, wildlife mortality from road-killed animals road-killed animals were found to be excessive, mitigation measures would be developed to reduce mortality risks. The transportation plan included with the combined agencies' alternatives also would reduce the risks of moose mortality from vehicle collisions.

Cumulative Effects

Alternative 1A would not contribute to cumulative impacts on moose. Cumulative effects of the mine action alternatives, in combination with other reasonably foreseeable actions would result in additional impacts to moose winter range, and could result in a decrease in the moose population in HD 105. Private land acquired for grizzly bear mitigation for the proposed project and other reasonably foreseeable actions could cumulatively improve or contribute suitable moose winter habitat if they potentially provided winter range characteristics and were managed to improve winter moose habitat. Thus, cumulative impacts could be reduced through road access changes and habitat acquisitions associated with mitigation for reasonably foreseeable actions.

3.24.7.2.4 Regulatory/Forest Plan Consistency

There are no specific KFP or regulatory standards for impacts to moose. Regulatory and KFP compliance for deer and elk guideline parameters have been discussed in section 3.24.3, *Management Indicator Species*.

3.24.7.3 State Species of Concern

3.24.7.3.1 Analysis Area and Methods

FWP and MNHP define Montana Species of Concern as "native animals breeding in the state that are considered "at risk" due to declining population trends, threats to their habitats, and/or restricted distribution" (FWP and MNHP 2006). State species of concern potentially impacted by the Montanore Project were determined according to their geographic and elevational range and habitat. Impacts to state species of concern were evaluated based on effects on broad vegetation communities described in section 3.21, *Vegetation* and effects on habitat that has been modeled for species with similar habitat requirements, specifically the black-backed woodpecker and the northern goshawk. Potential impacts on many state species of concern are addressed in section 3.24.4, *Forest-Sensitive Species* or 3.24.5, *Threatened, Endangered, and Proposed Species*. This section addresses impacts to the remaining terrestrial state species of concern potentially occurring in the analysis area. Impacts to aquatic species of concern are addressed in section 3.6, *Aquatic Life and Fisheries*.

The analysis area for evaluating direct, indirect, and cumulative project impacts to individuals and their habitat is the Crazy and Silverfish PSUs and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

Northern Goshawk

Goshawk population ecology, biology, habitat description, and relationships identified by research are described in McGrath *et al.* (2003) and Reynolds *et al.* (1992). That information is incorporated by reference. Goshawk occurrence data come from recent District wildlife observation records and KNF historical data (NRIS FAUNA). Potential goshawk habitat in the Crazy and Silverfish PSUs was estimated based on the KNF CEM and TSMRS vegetation data and the KNF CEM goshawk habitat model (see KNF project record). Goshawk habitat for private and state land outside of the Crazy and Fisher PSUs was based on old growth mapping, as described in section 3.21, *Vegetation*. The

potential population index, referred to as the PPI, for the northern goshawk was calculated based on an average goshawk pair territory of 5,400 acres (Reynolds *et al.* 1992).

3.24.7.3.2 Affected Environment

Vertebrate state species of concern potentially impacted by the Montanore Project are shown in Table 206. Detailed descriptions of physical characteristics, life history, habitat requirements, and distribution are available in the project record. The northern goshawk has been removed from the list of Forest Sensitive Species (McAllister 2007), but is listed as a state species of concern. Specific information about the northern goshawk is available for the analysis area and is summarized below.

Two historical goshawk nesting territories occur in close proximity to the Little Cherry Creek Tailings Impoundment Site. Both nests, one in the Bear Creek drainage and the other in the Little Cherry Creek drainage, were documented in 1983, and have not been known to be active since that date. No goshawk responses were detected during MNHP surveys of the two historical nesting territories in 2005 or 2006 (MNHP 2006b). No goshawks were observed during formal surveys conducted by the Forest Service from 2004 to 2006 near the proposed mine facilities, although one fledgling goshawk was observed in 2005 during surveys conducted in the Midas Creek drainage (see District files). The Forest Service conducted formal goshawk surveys in and adjacent to the proposed Montanore transmission line alignments during the summer of 2005 but did not detect any goshawks. No known or historical nesting territories have been documented in the Silverfish PSU. One potential nesting territory was found in August 2002 in Iron Meadow Creek, when two goshawks were encountered during an old growth survey. No nest tree was located (see District files). Despite the lack of recent goshawk observations, suitable habitat is available at several sites in the analysis area, and it is likely that northern goshawks are present in these areas at least seasonally (Westech 2005a).

Based on potential habitat from Johnson (1999) and the average goshawk pair territory, the minimum PPI for the KNF would be 139 goshawk pairs. Johnson (1999) shows goshawk presence confirmed in all eight planning units on the KNF. According to KNF data, there are 34 known or suspected pairs and an additional 10 known individual goshawks on the KNF. The Crazy PSU contains about 13,291 acres of potential goshawk habitat, while the Silverfish PSU contains about 12,852 acres of potential goshawk habitat, based on habitat modeling. Based on the average goshawk pair territory, the PPI for each of the PSUs is two goshawk pairs.

3.24.7.3.3 Environmental Consequences.

State sensitive species habitat potentially affected by the mine and transmission line alternatives is shown in Table 207 and Table 208 and described in the following subsections.

Alternative 1 – No Mine

Alternative 1 would have no impacts on state species of concern.

Table 206. State Species of Concern Potentially Impacted by the Montanore Project.

Common Name	Scientific Name	State Rank	Habitat	Habitat Used for Impacts Analysis
Fringed Myotis	*Myotis thysanodes*	S3	Riparian and dry mixed conifer forest	Wetland/riparian and coniferous forest
Boreal Chickadee	*Poecile hudsonica*	S1S2	Coniferous and mixed forests	Coniferous forest
Great Gray Owl	*Strix nebulosa*	S3	Coniferous forest	Coniferous forest
Lewis' Woodpecker	*Melanerpes lewis*	S2B	Open forest and woodland that may have been logged or burned, riparian forest	Previously harvested coniferous forest, wetland/riparian
Northern Goshawk	*Accipiter gentiles*	S3	Old growth and other mature, closed canopy forest; requires large coniferous or deciduous trees in older stands for nesting	Mature or old growth forest (modeled northern goshawk habitat)
Olive-Sided Flycatcher	*Contopus cooperi*	S3B	Early seral forest/shrub patches, including post-fire habitat	Recently burned forest and areas with high snag density (high-quality black-backed woodpecker habitat) and previously harvested coniferous forest
Northern Alligator Lizard	*Elgaria coerulea*	S3	Talus/rock outcrops in open areas or low canopy cover shrub or forest habitat	Previously harvested coniferous forest
Western Skink	*Eumeces skiltonianus*	S3	Open ponderosa pine woodland and open areas in or near talus	Coniferous forest, previously harvested coniferous forest
Gillette's Checkerspot	*Euphydryas gillettii*	S2	Wet meadows and clearcut areas	Wetland/ riparian habitat, previously harvested coniferous forest
Magnum Mantleslug	*Magnipelta mycophaga*	S1S3	Moist coniferous forest near water	Wetland/riparian habitat
Pygmy Slug	*Kootenai burkei*	S1S2	Moist coniferous forest	Wetland/riparian habitat
Robust Lancetooth	*Haplotrema vancouvernese*	S1S2	Moist coniferous forest	Wetland/riparian habitat
Sheathed Slug	*Zacoleus idahoensis*	S2S3	Mesic/moist coniferous forest	Wetland/riparian habitat
Smoky Taildropper	*Prophysaon humile*	S1S3	Moist coniferous forest	Wetland/riparian habitat

Key to State ranking codes:
S1-At high risk because of extremely limited and/or rapidly declining numbers, range, and/or habitat, making it highly vulnerable to extirpation in the state.
S2-At risk because of very limited and/or declining numbers, range, and/or habitat, making it vulnerable to global extinction or extirpation in the state.
S3-Potentially at risk because of limited and/or declining numbers, range, and/or habitat, even though it may be abundant in some areas.
B-Breeding season.

Alternative 2 – MMC's Proposed Mine

Species of concern most affected by Alternative 2 would be those associated with coniferous forest, followed by species associated with previously harvested coniferous forest (Table 207). About 72 acres of riparian and wetland areas providing potential habitat for species of concern would be affected by Alternative 2. All wetlands affected would be replaced with wetlands with similar functions and values. Alternative 2 would affect more coniferous forest community, regeneration harvest community, and riparian areas than the other mine alternatives. No known goshawk nests would be impacted in the analysis area. Goshawk habitat would not be impacted by Alternative 2 in the Silverfish PSU. About 511 acres of potential goshawk habitat would be lost as a result of Alternative 2, but these impacts would not change the existing PPI (Table 207). Alternative 2 would impact 473 acres of recently burned forest with snags providing potential habitat for the olive-sided flycatcher. At mine closure, disturbed habitat would be reclaimed, and habitat would return to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would take several decades. Alternative 2 may result in disturbance to some state species of concern, in particular the vertebrate species, due to noise and human presence associated with construction and operations. Disturbance effects could cause some species to move to less disturbed areas. Alternative 2 could result in the destruction of nests of bird species of concern or direct mortality of invertebrate species of concern. Although Alternative 2 could affect individuals, it would not likely result in population declines for species of concern.

Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

State species of concern associated with previously coniferous forest would be most affected by Alternative 3, followed by species associated with coniferous forest (Table 207). Alternative 3 would affect the least riparian and wetland areas providing potential habitat for state species of concern (about 5 acres). All wetlands affected would be replaced with wetlands with similar functions and values. In comparison to Alternative 2, Alternative 3 would result in 571 acres less total habitat lost than Alternative 2 because the tailings impoundment would be smaller and the plant site would be located in the same drainage as the adits (Table 141). Impacts to northern goshawk from Alternative 3 would be the same as Alternative 2, except that less habitat would be affected (409 acres) (Table 207). Alternative 3 would impact the least recently burned forest with snags providing potential habitat for the olive-sided flycatcher, affecting 261 acres. At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would take a considerable amount of time. Alternative 3 could result in disturbance to some state species of concern, in particular the vertebrate species, due to noise and human presence associated with construction and operations. Disturbance effects may cause some species to move to less disturbed areas. Alternative 3 may result in the destruction of nests of bird species of concern or direct mortality of invertebrates. Although Alternative 3 could affect individuals, it would not likely result in population declines for species of concern.

As described in the agencies' Wildlife Mitigation Plan (section 2.5.7.3, *Wildlife Mitigation*), Alternative 3 includes timing restrictions and pre-construction nest surveys for northern goshawks that would minimize the risk of nest destruction or abandonment for this species. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers and northern goshawks.

Table 207. Potential Impacts to State Sensitive Species in the Analysis Area by Mine Alternative.

Habitat Type	[1] No Mine Existing Condition	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment	[4] Agency Mitigated Little Cherry Creek Impoundment
Coniferous Forest (acres)	0	1,560	971	1,094
Previously Harvested Coniferous Forest (acres)	0	949	1,035	1,102
Wetland/Riparian Habitat (acres)	0	72	5	58
Mature or Old Growth Forest (acres)	0 (0)	511 (0)	309 (0)	499 (0)
Recently Burned Forest and Areas with High Snag Density (acres)	0	473	261	627

Number in parentheses is change in the potential population index (PPI) for the northern goshawk from existing conditions, based on an average goshawk pair territory of 5,400 acres.

Species associations are:

Coniferous forest - the boreal chickadee, great gray owl, and western skink.

Previously harvested coniferous forest - Lewis' woodpecker, olive-sided flycatcher, northern alligator lizard, western skink, and Gillette's checkerspot.

Wetland/ riparian habitat – fringed myotis, Lewis' woodpecker, Gillette's checkerspot, magnum mantlebug, pygmy slug, robust lancetooth, sheathed slug, and smoky taildropper.

Mature or old growth forest (goshawk habitat) delineated by Johnson (1999) model for National Forest System land and old growth mapped for private and state land in the analysis area – northern goshawk.

Recently burned forest and areas with high snag density (high-quality black-backed woodpecker habitat, as described in section 3.24.4, *Forest-Sensitive Species*) – olive-sided flycatcher.

Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Table 208. Potential Impacts to State Sensitive Species in the Analysis Area by Transmission Line Alternative.

Habitat Type	[A] No Trans-mission Line/ Existing Conditions	[B] MMC's Proposed Trans-mission Line (North Miller Creek Alternative)	[C] Modified North Miller Creek Trans-mission Line	[D] Miller Creek Trans-mission Line	[E] West Fisher Creek Trans-mission Line
Coniferous Forest (acres)	0	149	168	181	120
Previously Harvested Coniferous Forest (acres)	0	150	155	149	209
Wetland/Riparian Habitat (acres)	0	12	5	14	29
Mature or Old Growth Forest (acres)	0 (0)	42 (0)	26 (0)	31 (0)	37 (0)
Recently Burned Forest and Areas with High Snag Density (acres)	0	46	93	118	133

Number in parentheses is change in the potential population index (PPI) for the northern goshawk from existing conditions, based on an average goshawk pair territory of 5,400 acres.
Species associations are:

Coniferous forest - boreal chickadee, great gray owl, and western skink.

Previously harvested coniferous forest - Lewis' woodpecker, olive-sided flycatcher, northern alligator lizard, western skink, and Gillette's checkerspot.

Wetland/ riparian habitat – fringed myotis, Lewis' woodpecker, Gillette's checkerspot, magnum mantlebug, pygmy slug, robust lancetooth, sheathed slug, and smoky taildropper.

Mature or old growth forest (goshawk habitat) delineated by Johnson (1999) model for National Forest System land and old growth mapped for private and state land in the analysis area – northern goshawk.

Recently burned forest and areas with high snag density (high-quality black-backed woodpecker habitat, as described in section 3.24.4, *Forest-Sensitive Species*) – olive-sided flycatcher.

Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Impacts to state species of concern from Alternative 4 would be similar to Alternative 2, except that less coniferous forest and more previously harvest coniferous forest would be affected (Table 207). Alternative 4 would affect less riparian and wetland areas (about 58 acres) providing potential habitat for species of concern than Alternative 2 (about 72 acres). All wetlands affected would be replaced with wetlands with similar functions and values. Compared to other alternatives, Alternative 4 would impact the most recently burned forest with snags that provides potential habitat for the olive-sided flycatcher, affecting 627 acres. In comparison to Alternative 2, total habitat losses resulting from Alternative 4 would be 328 acres less because the plant site

would be located in the same drainage as the adits. Impacts to northern goshawk from Alternative 4 would be the same as Alternative 2, except that less habitat would be affected (399 acres) (Table 207).

At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would take a considerable amount of time. Alternative 4 could result in disturbance to some state species of concern, in particular the vertebrate species, due to noise and human presence associated with construction and operations. Disturbance effects could cause some species to move to less disturbed areas. Alternative 4 could result in the destruction of nests of bird species of concern or direct mortality of invertebrates. Although Alternative 4 could affect individuals, it would not likely result in population declines for species of concern. Surveys and timing restrictions described for Alternative 3 also would apply to Alternative 4.

Alternative A – No Transmission Line

Alternative A would not affect state species of concern habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Overall, Alternative B would affect the least amount of potential species of concern habitat compared to the other transmission line alternatives, due to a narrower clearing width (Table 208). Alternative B would affect about the same amount of coniferous forest and previously harvested coniferous forest providing potential habitat for associated species. No known goshawk nests would be impacted in either the Crazy or Silverfish PSU by Alternative B. About 42 acres of potential goshawk habitat would be lost as a result of Alternative B. These impacts would be too small to change the existing PPI. Alternative B would impact the least recently burned forest with snags, affecting 46 acres. At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would take a considerable amount of time. Alternative B could result in disturbance to some state species of concern, in particular the vertebrate species, due to noise and human presence associated with construction. However, disturbance effects would be short-term and would cease after transmission line construction. Alternative B could result in the destruction of nests of bird species of concern or direct mortality of invertebrate species of concern. Although Alternative B could affect individuals, it would not likely result in population declines for species of concern.

The likelihood of the 230-kV transmission line resulting in the electrocution of goshawks is extremely low; electrocution of raptors is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Also, electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and the Environmental Specifications (Appendix D).

Because they are highly maneuverable and do not generally fly in flocks, northern goshawks are generally less vulnerable to collisions with power lines than other bird species (Olendorff and Lehman 1986). Although unlikely, it is possible that Alternative B could result in an increased risk of goshawk mortality due to the potential for collisions with the transmission line. Potential collisions of goshawks with the transmission line would be minimized through implementation of recommendations outlined in APLIC (1994), and the Environmental Specifications (Appendix D).

As specified in the Environmental Specifications (Appendix D), Alternative B includes timing restrictions and pre-construction nest surveys for northern goshawks that would minimize the risk of nest destruction or abandonment for this species. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers and northern goshawks.

Alternative C – Modified North Miller Creek Transmission Line Alternative

Alternative C would impact slightly more coniferous forest and previously harvested forest providing potential habitat for species of concern than Alternative B (Table 208). Alternative C would impact wetland and riparian areas the least, affecting 5 acres. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Goshawk habitat would be the least impacted in Alternative C. About 93 acres of recently burned forest with snags providing potential habitat for the olive-sided flycatcher would be affected by Alternative C. Other impacts to state species of concern from Alternative C would be similar to Alternative B.

Alternative D – Miller Creek Transmission Line Alternative

Alternative D would have the greatest impacts on coniferous forest and associated species of concern (Table 208). About 31 acres of potential goshawk habitat would be lost as a result of Alternative D. Alternative D would affect 118 acres of recently burned forest with snags providing potential habitat for the olive-sided flycatcher. These impacts would be too small to change the existing PPI. Other impacts to state species of concern from Alternative D would be similar to Alternative B.

Alternative E – West Fisher Creek Transmission Line Alternative

Because Alternative E is the longest, overall it would have the greatest impacts on potential species of concern habitat of all the transmission line alternatives (Table 208). Impacts from Alternative E would be the greatest for previously harvested coniferous forest, affecting 209 acres. Alternative E would impact the most wetland and riparian habitat and recently burned forest with snags, affecting 29 and 133 acres, respectively. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Other impacts to state species of concern from Alternative E would be similar to Alternative B.

Combined Mine-Transmission Line Effects

Impacts to state species of concern are shown in Table 209 and discussed in the following paragraphs.

Alternative 2B would impact the most coniferous forest providing habitat for associated species (1,709 acres), while Alternative 3E would impact the least (1,091 acres). Previously harvested coniferous forest would be most affected by Alternative 4E, which would affect 1,311 acres. Alternatives 2B and 4E would have similar impacts on wetlands and riparian habitats, affecting 84 and 87 acres, respectively. In all combined action alternatives, direct effects to wetlands from the transmission line are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S., and all wetlands affected by the mine would be replaced with wetlands with similar functions and values. The goshawk would be most affected by Alternative B, which would result in the loss of 519 acres of

goshawk habitat. The goshawk would be least affected by Alternative 4C, which would affect 425 acres. Recently burned forest with snags providing potential habitat for the olive-sided flycatcher would be most affected by Alternative 4C, which would impact about 745 acres of habitat.

Table 209. Potential Impacts to State Sensitive Species Habitat in the Analysis Area by Combined Mine-Transmission Line Alternative.

Habitat Type	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Cherry Creek Impoundment Area		
	TL-B	TL-C	TL-D	TL-E	TL-C	TL-D	TL-E
Coniferous Forest (acres)	1,709	1,139	1,152	1,091	1,262	1,275	1,214
Previously Harvested Coniferous Forest (acres)	1,054	1,190	1,184	1,244	1,257	1,251	1,311
Wetland/Riparian Habitat (acres)	84	10	19	34	63	72	87
Mature or Old Growth Forest (acres)	553	435	440	446	425	430	436
Recently Burned Forest and Areas with High Snag Density (acres)	519	354	379	364	720	745	730

Species associations are:

Coniferous forest - boreal chickadee, great gray owl, and western skink.

Previously harvested coniferous forest - Lewis' woodpecker, olive-sided flycatcher, northern alligator lizard, western skink, and Gillette's checkerspot.

Wetland/riparian habitat – fringed myotis, Lewis' woodpecker, Gillette's checkerspot, magnum mantlebug, pygmy slug, robust lancetooth, sheathed slug, and smoky taildropper.

Mature or old growth forest (goshawk habitat) delineated by Johnson (1999) model for National Forest System land and old growth mapped for private and state land in the analysis area – northern goshawk.

Recently burned forest and areas with high snag density (high-quality black-backed woodpecker habitat, as described in section 3.24.4, *Forest-Sensitive Species*) – olive-sided flycatcher.

Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

In all combined action alternatives, disturbed habitat would be reclaimed at mine closure, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would likely take centuries. All combined action alternatives could result in disturbance to some state species of concern, in particular the vertebrate species, due to noise and human presence associated with construction and operations. Disturbance effects could cause some species to move to less disturbed areas. All combined action alternatives could result in the destruction of nests of bird species of concern or direct mortality of invertebrates. Although all combined action alternatives could affect individuals, they would not likely result in population declines for species of concern.

In all combined action alternatives, the likelihood of the 230-kV transmission line resulting in the electrocution of goshawks is extremely low; electrocution of raptors is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Also, electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches

between phases or between phase and ground wires, and the Environmental Specifications (Appendix D).

Because they are highly maneuverable and do not generally fly in flocks, northern goshawks are generally less vulnerable to collisions with power lines than other bird species (Olendorff and Lehman 1986). Although unlikely, it is possible that the action alternatives could result in an increased risk of goshawk mortality due to the potential for collisions with the transmission line. Potential collisions of goshawks with the transmission line would be minimized through implementation of recommendations outlined in APLIC (1994), and the Environmental Specifications (Appendix D).

In all combined action alternatives, as specified in the Environmental Specifications (Appendix D), and the agencies' Wildlife Mitigation Plan (sections 2.5.7.3, *Wildlife Mitigation* and 2.9.4, *Wildlife Mitigation Measures*), either tree removal would not occur during the breeding season for northern goshawks, or surveys would be conducted in potential habitat for this species prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to northern goshawks. Alternative 2B does not include timing restrictions or northern goshawk surveys of the mine disturbance area.

Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire-suppression activities, have altered the analysis area, resulting in a reduction in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; increases in tree density; and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provided access to old growth habitat, contributing to removal of snags important to several state species of concern, such as the boreal chickadee, Lewis' woodpecker, northern alligator lizard, and western skink. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of forested habitat in the analysis area.

The Miller-West Fisher Vegetation Management Project would include regeneration harvest of about 475 acres, slash treatment of 681 acres, and prescribed burning of 3,751 acres of National Forest System lands in the Silverfish PSU. Timber harvest and other clearing activities planned for the Miller-West Fisher Vegetation Management Project in the Silverfish PSU would contribute to cumulative losses of coniferous forest habitat and snags and down wood. However, activities associated with the Miller-West Fisher Vegetation Management Project are expected to retain cavity habitat within KFP-recommended levels for the Silverfish PSU. Also, prescribed burns associated with the Miller-West Fisher Vegetation Management Project would create habitat for the olive-sided flycatcher and other state species of concern found in open habitats. Surface disturbance from other reasonably foreseeable actions in the analysis area would be minimal. The combined action alternatives, in combination with other reasonably foreseeable actions could result in cumulative noise and other human-caused disturbance to bird species of concern and the fringed myotis, causing them to move to less disturbed areas.

3.24.7.3.4 Regulatory/Forest Plan Consistency

KFP. With the incorporation of the KFP amendment discussed in section 3.24.3, *Management Indicator Species*, all agencies' combined mine-transmission line alternatives would meet all KFP

direction for general forest MIS species (*i.e.*, white-tailed deer and elk) representing moose (KFP Vol. 1, II-22 #3, III-45 #8, and III-49 #7).

During transmission line construction, Alternatives 3D, 3E, 4D, and 4E would increase ORD in areas currently managed as MA 12. All action alternatives would include a project-specific amendment to the KFP to change MA 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment would be for the duration of the proposed Montanore Project. KFP amendments have been discussed in section 3.14, *Land Use*. All new or opened roads in MA 12 associated with the transmission line would be within the 500-foot corridor reallocated as MA 23.

The action alternatives could impact individuals and/or their habitat, but would not contribute to a trend toward federal listing or loss of species viability for state species of concern. Coniferous forest, previously harvested coniferous forest, wetland and riparian habitat, goshawk habitat, and black-backed woodpecker habitat providing potential habitat for state species of concern would be disturbed, but a small proportion of available habitat would be impacted. Sufficient habitat within the in the analysis area would likely remain to support existing populations of state species of concern.

3.24.7.4 Irreversible and Irretrievable Commitments

All disturbed areas would be reclaimed and revegetated at mine closure. With the exception of old growth habitat, there would be no irreversible commitments of habitat for moose or state species of concern due to any of the action alternatives. Action alternatives would result in an irreversible commitment of old growth forest providing potential goshawk habitat. The recovery time of old growth forest would preclude restoration for centuries following disturbance.

Irretrievable commitments of moose winter range and calving habitat would occur in the Crazy and Silverfish PSUs due to disturbance from the impoundment, LAD Areas, plant site, and other mine facilities, and construction of the transmission line. Irretrievable commitments of species of concern habitat would occur in all action alternatives. In all action alternatives, recovery of moose winter range and calving habitat and species of concern habitat would not occur until after mine closure and reclamation.

3.24.7.5 Short-term Uses and Long-term Productivity

Most losses of moose winter range and calving habitat and species of concern habitat resulting from the action alternatives would last until mine closure and reclamation. Noise and other human-caused disturbance to moose and species of concern would be short-term during the construction phase. Disturbance created by mine operations would last through reclamation, although it would be less intense after the mine was closed.

3.24.7.6 Unavoidable Adverse Environmental Effects

Unavoidable adverse effects to moose and state species of concern would occur from all action alternatives in the analysis area due to losses of habitat where new roads were constructed, mine facilities were built, and the transmission line were constructed.

3.25 Other Required Disclosures

3.25.1 Environmental Justice

Executive Order 12898, Environmental Justice requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations when implementing their respective programs, including American Indian programs. The lead agencies' analysis of Environmental Justice follows the CEQ's guidance on Environmental Justice, (CEQ 1997), the EPA's guidance on Environmental Justice (EPA 1998, 1999) and the U.S. Department of Agriculture's regulation on Environmental Justice (USDA 1997b). These documents suggest a step-wise evaluation of Environmental Justice: identification of minority and low-income populations; assessment of effects and determination if the effects would be disproportionately high and adverse, and mitigation. The U.S. Department of Agriculture's regulation indicates an effect on a minority or a low-income population is disproportionately high and adverse if the adverse effect is appreciably more severe or greater in magnitude than the adverse effect that will be suffered by the non-minority population and/or non-low-income population.

No minority and low-income populations live in the analysis area. American Indians are a minority population, and although the proposed mine is not located within or adjacent to any tribal reservations, it is located within the boundaries of land covered by the Hell Gate Treaty (see section 3.5, *American Indian Consultation*). All action alternatives would restrict access to mine facility sites to all members of the public, including tribal members. Proposed mitigations in all action alternatives would reduce the effects of access restrictions. The access restrictions would not be disproportionately high and adverse on any minority and low-income population.

3.25.2 Important Farmland, Rangeland, and Forestland

The Farmland Protection Policy Act and USDA Departmental Regulation No. 9500-3 provide protection for important farmland, prime forest land, and prime rangeland. The USDA regulation, 7 CFR Part 658, implements the Farmland Protection Policy Act. The alternatives analyzed in detail would be in compliance with regulations for prime lands. The definition of prime forest land does not apply to lands within the KNF. Lands administered by the Forest Service in the analysis area do not include any important farmlands or prime range lands. In all alternatives, federal lands would be managed with the appropriate consideration to the effects on adjacent lands.

3.25.3 Energy Requirements and Conservation Potential

Alternatives requiring the most construction would have the least potential for conserving energy. The maximum annual energy consumed by all alternatives is estimated at 406,000 megawatts, using a peak demand of 50 megawatts. The amount of energy required to implement any of the action alternatives, in terms of petroleum products, would be insignificant when viewed in light of the production costs and effects of the national and worldwide petroleum reserves.

3.25.4 Urban Quality and the Design of the Built Environment

Implementation of any of the action alternatives would not affect urban quality. No buildings or other forms of man-made structures would be affected by any of the alternatives.

Chapter 4. Consultation and Coordination

4.1 Preparers and Contributors

4.1.1 Forest Service

Name	Responsibilities	Education	Experience
Ague, Susan	GIS/Editorial Assistant (2005-2006)		14 years
Bond, Deb	Vegetation/Sensitive Plants	B.S., Forestry Resource Management	27 years
Bratkovich, Al	Wildlife	B.S., Forest Science	31 years
Bones, Stan	Explosives	B.S., Forest Management	37 years
Brundin, Lee	Wildlife	B.S., Fisheries & Wildlife Management	34 years
Carlson, John	Fisheries	M.S., Fisheries B.S., Fisheries	23 years
Edwards, Malcolm	Ranger	B.S., Soils/Range	32 years
Ferguson McDougall, Leslie	NEPA	B.S., Forestry	25 years
Grabinski, Tom	Lands	B.S., Civil Engineering	39 years
Gubel, John	NEPA	B.S., Forestry	27 years
Gurrieri, Joe	Hydrology	M.S., Geology B.A., Geography/Geology	24 years
Hooper, Paul	Fisheries	B.S., Fisheries Biology	17 years
Jeresek, Jon	Recreation	M.S., Forest Pathology	32 years
Johnson, Wayne	Wildlife	B.S., Wildlife Management	33 years
Lacklen, Bobbie	Project Coordinator	B.A., Geology	22 years
Lampton, Linda	GIS	A.A., Business	25 years
Leavell, Dan	Ecology	Ph.D., Ecology M.S., Forest Ecology B.S., Forestry Resource Management	35 years
McKay, John	Geology	B.A., Geology	27 years
Niccolucci, Michael	Socioeconomics	B.A., Economics M.A., Economics	27 years
Odor, Ann	Weeds	B.S., Forestry Resource Management	21 years
Romero, Stephen	Dam Specialist (2005-2007)	M.S., Civil Engineering B.S., Environmental Engineering B.A., Mathematics	10 years
Smith, Lawrence	Forester	A.A., Forestry	36 years
Stantus, Paul	Engineer	B.S., Civil Engineering	31 years
TeSoro, Ray	RO Minerals	B.S., Geology	28 years
Thomas, Pat	Scenery	B.S., Landscape Architecture	34 years
Timmons, Becky	Heritage/American Indian	M.A., Anthropology B.A., Anthropology	28 years
Werner, Peter	Geotechnical	M.S., Mining Engineering Double B.S., Civil Engineering and Geology	18 years

Name	Responsibilities	Education	Experience
Young, Barb	GIS	M.S., Work, Soils B.A., Geology	21 years
Wegner, Steve	Hydrology	B.S., Watershed Management	25 years
White, Mark	Heritage	Double B.S., Anthropology and History	23 years

4.1.2 Department of Environmental Quality

Name	Responsibilities	Education	Experience
Blend, Jeff	Socioeconomics	Ph.D., Agricultural Economics M.S., Economics B.S., Economics	9 years
Boettcher, Lisa	Hydrogeology Overall Resource Review	M.S., Geology and Geological Engineering B.S., Geology	19 years
Castro, James	Geochemist	Ph.D., Geochemistry M.S., Physical Chemistry	35 years
Freshman, Charles	Engineering	M.S., Geological Engineering B.A., Geology B.S., Environmental Engineering	25 years
Furniss, George	Hydrogeology	M.S., Geology B.S., Geology	34 years
Jepson, Wayne	Hydrology	M.S., Geology B.A., Earth Sciences	16 years
Johnson, Kathleen	Project Coordinator and Document Review (2005-2007)	M.S., Land Rehabilitation B.S., Landscape Architecture	20 years
Johnson, Nancy	Transmission Line – Major Facility Siting Act	M.L.A., Landscape Architecture M.S., Education B.S., Education	26 years
Jones, Craig	Transmission Line	B.A., Political Science	1 year
Lovelace, Bonnie	Project Coordinator and Document Review (2007 to present)	M.S., Geology B.S., Geology B.S., Mathematics	25 years
McCullough, Warren	Document Review	M.S., Economic Geology B.A., Anthropology	32 years
O'Mara, Jenny	Air Quality Permit and Review	B.S., Environmental Engineering	13 years
Plantenberg, Patrick	Overall Resource Review	M.S., Range Science/Reclamation Research B.S., Plant & Soil Science/Recreation Area Management	35 years
Ridenour, Rebecca	MPDES Permit and Water Quality Review	M.S., Geoscience - Geochemistry B.S., Geological Engineering, Hydrogeology Emphasis	10 years
Ring, Tom	Major Facility Siting Act Certificate Coordination	Double B.S., Fish and Wildlife Management and Earth Science	27 years
Rolfes, Herb	Operating Permit Supervisor and Document Review	M.S., Land Rehabilitation B.A., Earth Space Science, A.S., Chemical Engineering	20 Years

Name	Responsibilities	Education	Experience
Skubinna, Paul	MPDES Permit and Water Quality Review (2005–200)7	M.S., Geology B.S., Earth Science	5 years
Thunstrom, Eric	Air Quality Permit and Review (2005–2007)	B.A., Environmental Engineering	1.5 years

4.1.3 EIS Consultant Team

Name/Firm	Responsibilities	Education	Experience
Baud, Karen ERO Resources Corp.	Assistant Project Manager; Wildlife (2006 to present)	M.A., Biology B.A., Biology	18 years
Bauer, Wayne HDR Engineering, Inc.	Electrical Engineering	B.S., Electrical Engineering	23 years
Bergstedt, Lee GEI Consultants, Inc.	Aquatic Life and Fisheries (2007 to present)	M.S., Fishery and Wildlife Biology B.A., Fish and Wildlife Management	13 years
Canton, Steve GEI Consultants, Inc.	Aquatic Life and Fisheries	M.S., Zoology B.A., Biology	30 years
Clark, Martha ERO Resources Corp.	Technical Editor	B.A., English	22 years
Cole, Andy ERO Resources Corp.	Socioeconomics	M.F.S. Forest Science M.A., German B.A., German/Physics	13 years
Galloway, Barbara ERO Resources Corp.	Hydrology	M.S., Water Resources Double B.A., Biology and Environmental Studies	23 years
Galloway, Michael ERO Resources Corp.	Hydrogeology	M.S., Geology B.S., Geology	37 years
Gilbride, Leo Agapito and Associates, Inc.	Mine Engineering	M.S., Mining Engineering B.S., Civil Engineering	11 years
Grant, Julia ERO Resources Corp.	Assistant Project Manager; Land Use (2005–2006)	M.E.M., Resource Ecology M.F., Forest Resources B.A., Political Science	7 years
Hesker, David ERO Resources Corp.	Graphics	B.F.A., Concentration in Graphic Design	18 years
Hereim, Scott HDR Engineering, Inc.	Electrical Engineering	B.S., Electrical Engineering	9 years
Hodges, Wendy ERO Resources Corp.	Geographic Information Systems	M.S., Environmental Policy and Management B.S., Natural Science	6 years
Holdeman, Mark Holdeman Landscape Architecture, Inc.	Visual	B.L.A., Landscape Architecture	26 years
Kirk, Lisa Enviromin, Inc.	Geochemistry	Ph.D., Microbial Geochemistry M.S., Aqueous Geochemistry B.S., Geology and Environmental Science	23 years

Name/Firm	Responsibilities	Education	Experience
Larmore, Sean ERO Resources Corp.	Cultural Resources	M.A., Archaeology B.A., Anthropology	11 years
Lynch, Jeniffer GEI Consultants, Ltd.	Aquatic Life and Fisheries (2005-2007)	M.S., Environmental Science B.S., Biology	2 years
Lyons, Carol Bridges Unlimited, LLC.	Air Quality	M.S., Chemical Engineering Double B.S., Chemistry and Physics	30 years
Mangle, Bill ERO Resources Corp.	Land Use, Recreation, Wilderness, and Inventoried Roadless Areas	M.S., Natural Resource Policy and Planning B.S., History/Political Science	12 years
Poulter, Don Glasgow Engineering Group, Inc.	Geotechnical	M.S.C.E., Geotechnical Engineering B.S., Civil Engineering	29 years
Sheppard, Asher Asher Sheppard Consulting	Electric and Magnetic Fields	Ph.D., Physics M.S., Physics B.A., Science	30 years
Smith, Garth ERO Resources Corp.	Geographic Information Systems	M.A., Geography B.S., Geography	14 years
Stanwood, Mike ERO Resources Corp.	Socioeconomics	M.S., Mineral Economics B.A., Psychology	28 years
Trenholme, Richard ERO Resources Corp.	Project Management	B.S., Agronomy	30 years
Trujillo, Cindy ERO Resources Corp.	Wetlands and Vegetation	B.S., Biology	8 years
Vandergrift, Tom Agapito and Associates, Inc.	Mine Engineering	M.S., Mining Engineering B.S., Mining Engineering	20 years
Wall, Kay ERO Resources Corp.	Document Production	B.A., Behavioral Science	29 years

The Forest Service and DEQ consulted the following individuals, federal, state, and local agencies and agency personnel during the development of this EIS.

4.1.4 Other Federal, Tribal, State and Local Agencies

Name/Agency or Tribe	Responsibilities
Brown, Jerry Montana Fish, Wildlife, and Parks	Wildlife
Conard, Ben U.S. Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Goldsberry, Cheryl U.S. Army Corps of Engineers	Wetlands and 404 Permit
Hafferman, Kurt Montana Department of Natural Resources and Conservation	Water Rights
Kasworm, Wayne U.S. Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Konzen, John Lincoln County Commissioner	Document Review

LaForest, Joe Montana Department of Commerce, Hard Rock Mining Impact Board	Hard Rock Impact Plan Socioeconomics
Lynard, Gene Bonneville Power Administration	Sedlak Park Substation and Loop Line
Peter, Chandler U.S. Army Corps of Engineers	Wetlands and 404 Permit
Riley, Jean Montana Department of Transportation	State Highways
Roose, Marianne Lincoln County Commissioner	Document Review
Sandman, Robert Department of Natural Resources and Conservation	Trust Lands
Steinle, Allan U.S. Army Corps of Engineers	Wetlands
Williams, Jim Montana Fish, Wildlife, and Parks	Wildlife
Wilson, Mark USDI Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Windom, Rita Lincoln County Commissioner	Document Review

4.2 List of Agencies, Organizations and Person to Whom Copies of the Draft EIS Have Been Distributed

This EIS or its Summary has been distributed to individuals who specifically requested a copy of the document either in hard or electronic copy. In addition, copies have been sent to the federal agencies, tribal governments, state and local governments, and organizations representing a wide range of views regarding the proposed Montanore Project. The mailing list was compiled using the names and addresses of the following:

- Parties who participated in public meetings or who submitted written comments
- Parties who have requested copies of the EIS
- Agencies, governments, tribes, and companies potentially affected by the proposed operation
- Agencies and groups consulted during the EIS preparation

A copy of this Draft EIS can be reviewed at the following locations or via the Internet on the Forest Service web page (http://www.fs.fed.us/r1/kootenai/projects/projects/montanore/index.shtml) or the DEQ web page (http://www.deq.state.mt.us/eis.asp):

- Supervisor's Office, Kootenai National Forest, Libby, MT
- Libby Ranger Station, Libby, MT
- Montana Department of Environmental Quality, Helena, MT
- Montana State Library
- Mansfield Library, University of Montana, Missoula, MT

- Lincoln County Library, Libby, MT
- Thompson Falls Public Library, Thompson Falls, MT
- Laurie Hill Library, Heron, MT

Copies of this document are also available on request from:

Kootenai National Forest 31374 U.S. 2 West Libby, MT 59923-3022 (406) 293-6211	Montana Department of Environmental Quality PO Box 200901 Helena, MT 59620-0901 (406) 444-1760	Bonneville Power Administration PO Box 3621 Portland, OR 97208-3621 (503) 230-7334

The following agencies, organizations, and individuals received a copy of the Draft EIS or summary:

4.2.1 Federal, State, or Local Agencies

Advisory Council on Historic Preservation
Army Corps of Engineers
Bonneville Power Administration
Boundary Co Land Use Committee
British Columbia Ministry of Energy, Mines and Petroleum Resources
British Columbia Ministry of Environment
British Columbia Ministry of Forest and Range
Bureau of Land Management
City of Libby
Coeur D'Alene Tribe
Colville National Forest
Confederated Salish-Kootenai
County Commissioner Boundary
County Commissioner Lincoln
County Commissioner Sanders
Environmental Protection Agency
Environmental Protection Agency Region 10
Environmental Protection Agency Region 8
Federal Aviation Administration
Federal Energy Regulatory Commission
Federal Highway Administration
Federal Railroad Administration
Forest Service Governors Office
ID Dept of Agriculture
ID Dept of Environmental Quality
ID Dept of Fish and Game
ID Dept of Lands
ID Dept of Parks and Recreation
ID Dept of Water Resources
ID Office of Species Conservation
ID Senator Jim Risch
ID St Representative Eric Anderson
ID St Senator Shawn Keough
ID State Historic Preservation Office
ID State Historical Society
ID Water Resource Board
Kootenai County Building and Planning Dept
Kootenai National Wildlife Refuge
Kootenai Tribe of ID
Lakes Commission
Legislative Consumer Counsel
Libby Creek Ventures
Libby Public Schools
Lincoln County
Lincoln County Library
Lincoln County Weed and Rodent Program
MT Bureau of Mines and Geology
MT Department of Revenue
MT Department of Transportation
MT Dept of Agriculture
MT Dept of Commerce
MT Dept of Environmental Quality
MT Dept of Natural Resources and Conservation
MT Environmental Quality Counsel
MT Fish Wildlife and Parks
MT Governor Brian Schweitzer
MT Natural Heritage Program
MT Representative Dennis Rehberg
MT Senator Jon Tester
MT Senator Max Baucus
MT St Representative Chas Vincent
MT St Representative Pat Ingraham
MT St Senator Aubyn Curtiss
MT St Senator Jim Elliott
MT State Historic Preservation Office
MT State Library
Natural Resources Conservation Service
Northwest Indian Fisheries Commission
Office of NEPA Policy and Compliance
Public Service Commission
Rocky Mountain Research Station
The City of Troy
Thompson Falls Public Library
Tribal Liaison/KNF
Troy Rural Fire District
U.S. Dept. of Agriculture
U.S. Dept. of Labor

U.S. Dept. of the Interior
U.S. Dept. of Transportation
US Coast Guard
US Geological Survey
USDA APHIS PPD/EAD
USDA Forest Service
USDA National Agricultural Library
USDA Natural Resources Conservation Service
USDI Fish and Wildlife Service
USDI Office of Environmental Policy and Compliance
WA Conservation Commission
WA Dept Fish and Wildlife
WA Dept of CTED
WA Dept of Ecology
WA Dept of Natural Resources

4.2.2 Organizations and Businesses

Organizations

Alliance for the Wild Rockies
Amber Public Land Exchange
American Fisheries Society
American Forest and Paper Assn
American Sportfishing Assn
American Wildlands
Avery Area Property Owners Assn
Back Country Houndsmen
Backcountry ATV
Backcountry Horsemen
Backcountry Hunters and Anglers
Biodiversity Legal Foundation
BlueRibbon Coalition
Boone and Crockett Club
Boundary Backpackers - Idaho Conservation League
Bowhunting Preservation Alliance
Bull River Watershed Council
Cabinet Back Country Horsemen
Cabinet Mountains Pika Club
Cabinet Resource Group
Capital Trail Vehicle Assn
Center For Justice
Clark Fork Bass Anglers
Clark Fork Pend Oreille Conservancy
Committee For Idahos High Desert
Communities for a Greater Northwest
Concerned About Grizzlies
Cutthroat Trout Foundation Inc.
Defenders of Wildlife
Earthworks
Eastern Sanders Co Sportsmen
Elk Unlimited
Estuary Corporation
Eureka Dune Runners
Five Valleys Audubon Society
Flathead Lutheran Bible Camp
Flathead Wildlife, Inc.
Foundation For N American Wild Sheep
Friends of Clearwater
Friends of Scotchmans Pk Wldrns
Friends of the Clearwater
Gonzaga Spokane Mountaineers
Great Bear Foundation
Great Burn Study Group
Great Old Broads For Wilderness
Healthy Communities Initiative
High Mountain ATV Assn
Idaho ATV Association Inc.
Idaho Conservation Data Center
Idaho Conservation League
Idaho Environmental Council
Idaho Forest Owners Assn
Idaho Forest Owners Association
Idaho Native Plant Society
Idaho Outfitters and Guides Licensing Board
Idaho Rivers United
Idaho State Snowmobile Assn
Idaho Trout Unlimited
Idaho Women In Timber
Independent Forest Products Assn
Intermountain Forest Assn
International Assn of Fish and Wildlife Agencies
International Mountain Bicycling Association
Kettle Range Conservation Group
Kinnikinnick Chapter of the ID Native Plant Society
Klamath Alliance For Resources and Environment
Kootenai Environmental Alliance
Kootenai Flyfishers
Kootenai Ridge Riders ATV
Kootenai River Development Council
Kootenai River Network
Kootenai Wildlands Alliance
Kootenay Lake Forest District
Libby Area Chamber of Commerce
Libby Rod and Gun Club
Libby Tomorrow
Libby Video Club
Lincoln County Recreation Assn & Troy Snowmobile Club
Lincoln County Sno Kats
Lower Clark Fork Watershed Group
Mansfield Library
Marion Co Humane Society Inc.
Militia of MT
Missoula Bicycle Club
Montana Env. Info. Center
Montanans for Multiple Use
Mountain States Legal Foundation
MT Chapter American Fisheries Society
MT Conservation Corps
MT Native Plant Society
MT Night Riders
MT Petroleum Assn
MT Pilots Assn
MT Snowmobile Assn
MT Trail Vehicle Riders Assn
MT Wilderness Assn
MT Wildlife Federation
MT Wood Products Assn
N ID Audubon Society
N ID Backcountry Horsemen
N ID Trail Blazers and Pacific NW Four Wheel Drive Assoc
N ID Trailblazers
National Audubon Society

National Resources Defense Council
National Rifle Assn
National Shooting Sports Foundation
National Wild Turkey Federation
National Wildlife Federation
Native Forest Network
Nitha
Non-Profit Offroad Community
North Fork Forestry
Northwest Access Alliance
Northwest Coalition for Alt To Pesticides
Northwest Environmental Defense Center
Northwest Mining Association
Northwest Power Planning Council
Noxon Rod and Gun Club
Oregon State Snowmobile Assn
Pacific Legal Foundation
Pacific Northwest Four Wheel Drive Assn
Pacific Rivers Council
Panhandle Trail Riders Assn
Pantra
People For Wyoming
Pilik Ridge RUA
Predator Conservation Alliance
Priest Lake Groomer Committee
Priest Lake Permittees Assn
Priest Lake Trails and Outdoor Rec Assn
Priest River Valley Back Country Horseman
Public Lands Foundation
Recreational Boating and Fishing Foundation
Rock Cr Subdivision RUA
Rock Creek Alliance
Rocky Mountain Elk Foundation
Rocky Mountain Forest District
Sanders County Winter Recreation
Sandpoint Ski Hut Assn
Sandpoint Winter Riders
Save Our Earth
Sci First For Hunters
Selkirk Conservation Alliance
Selkirk Conservation Assn
Sierra Club
Sierra Club Legal Defense Fund
Smoky Mountains Hiking Club
Snow Riders
Snowmobile Alliance of Western States
Society of American Foresters
Spokane Mountaineers
Spokane Mountaineers Conservation Committee
St Joe Cycle Club City of St Maries Council
St Joe Snow Riders
Stenros Brothers Outdoor Adventures
Ten Lakes Snowmobile Club
The Coalition
The Ecology Center
The Lands Council
The Nature Conservancy
The Wilderness Society
Theodore Roosevelt Conservation Partnership
Tobacco Valley Resource Group
Tobacco Valley Study Group
Treasure State Alliance
Trout Unlimited
Troy & Libby Snowmobile Clubs
Vital Ground Foundation
Western Environmental Trade Assn
Western Land Exchange Project
Western Mining Action Project
Western MT Bldg and Construction Trades Council
Western MT Building Trades
Wildlands CPR
Winter Riders Inc.
Winter Wildlands Alliance
Wyoming Wilderness Assn
Yaak Rod and Gun Club
Yaak Valley Forest Council

Businesses

10 Lakes Forestry and Excavation
1st Natl. Bank
AAAuto Mobile Car Doctor
Associated Logging Contractors, Inc.
Avista Corp.
BKS Environmental Associates, Inc.
Boliden Resources, Inc.
C.K. Presley & Associates, Inc.
Calvert Ranch
Camp, Dresser & McKee, Inc.
Canavan Logging
CBS News 60 Minutes
Cecil Goff Clipping
Cedapine Veneer Inc.
Chalkstream Capital Group
Charlie Carvey Logging
Citizens Telecom of MT
Columbia Helicopters Inc.
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Conservation Research and Management Consulting Services
Daily Interlake
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Diversified House Logs Inc.
Dresser Ind. Inc.
Edlund and Hayes
Environmental Strategies Inc.
Environomics Inc.
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Eureka Rural Dev Partners
FH Stoltze Land and Lumber Co.
Flathead Electric Cooperative, Inc.
Franklin and Associates
Gaetz, Madden & Dunn
Genesis Inc.
Golden Sunlight Mines
Harding Lakes Ranch
Hecla Mining Co.
Hershberger's Treasure Mountain Fence
Highland Logging
Highland Resources, Inc.
Hollingsworth Ranch LLC
Jenson & Mills
Kentucky Heartwood
Kovar Properties LLC
KPAX-TV
Lance and Posten
Libby Creek Ventures

Libby Placer Mining Company
Lightning Excavating
Line Layers Inc
Linehan Outfitting Co.
Lisa Bay Planning and Resource Mgmt.
Little Bitterroot Special Services, Inc.
Louisiana Pacific Corp.
Mines Management Inc.
Minturn and Murnane
Monenco Consultants, Ltd.
Montanian Newspaper
N.A. Degerstrom, Inc.
Neff & Nayes
Nerco Exploration Co.
Noranda Inc Falconbridge Ltd.
Noranda Minerals Corp.
Northern Lights, Inc.
Orvana Resources Corp.
Owens and Hurst Lumber Co Inc.
Payne Machinery, Inc.
Plum Creek Marketing
Plum Creek Timber Co.
PRC Environmental Management, Inc.
Raviv & Patricio Associates, Inc.
Revett Silver Co.
Ridin P Ranch
Riley Creek Lumber
Rovig Minerals, Inc.
Rusher Air Conditioning
Sanders County Ledger
Silver Bow Outfitters
Silver Butte Ranch Corp.
Smurfit Stone Container Corp.
Spokesman Review
St. John's Lutheran Hospital
Stein and Preston
Stimson Lumber Co.
T B C Timber Inc.
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The Missoulian
The Montanian
Timber Tech, Inc.
Timberline Auto Center, Inc.
Tungsten Holdings Inc
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Western Resources Dev. Co.
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W-I Forest Products

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Chapter 6. List of Acronyms

Acronym	Acronym Description
ABA	Acid-Base Accounting
ABP	Acid-Base Potential
ADT	Average Daily Traffic
AERMIC	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee
AERMOD	Air Dispersion Model
AIRFA	American Indian Religious Freedom Act
ALS	Aquatic Life Standard
ANC	Acid-Neutralizing Capability
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
AQRV	Air Quality Related Values
ARD	Acid Rock Drainage
ARMB	Montana Air Resources Management Bureau
ASARCO	American Smelting and Refining Company
BA	Biological Assessment
BAA	Bear Activity Area
BACT	best available control technology
BCI	Biotic Community Index
BE	Biological Evaluation
BHES	Board of Health and Environmental Sciences
BLM	Bureau of Land Management
BLM	Biotic Ligand Model
BMP	best management practice
BMU	Bear Management Unit
BO	Biological Opinion
Borax	U.S. Borax and Chemical Corporation
BORZ	(Grizzly) Bear Outside the Recovery Zone
BPA	Bonneville Power Administration
BPT	best practicable control technology
CEM	Cumulative effects model
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMW	Cabinet Mountains Wilderness
CO	carbon monoxide
Corps	U.S. Army Corps of Engineers
DAT	Deposition Analysis Threshold
dB	decibel
dBμV/m	decibel-microvolts per meter
dbh	diameter at breast height
Draft EIS	Draft Environmental Impact Statement
DEQ	Montana Department of Environmental Quality
DHES	Montana Department of Health and Environmental Sciences (now DEQ)

Acronym	Acronym Description
DNRC	Montana Department of Natural Resources and Conservation
DOC	Montana Department of Commerce
DSL	Montana Department of State Lands (now DEQ)
EA	Environmental Assessment
Eagle Act	Bald and Golden Eagle Protection Act
ECA	Equivalent Clearcut Acres
ECAC	Equivalent Clearcut Acres Calculator
EIS	Environmental Impact Statement
ELGs	Effluent Limitations Guidelines
EMF	Electric Field and Magnetic Field
EMU	Elk Management Unit
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ER	Enrichment Ratio
ESA	Endangered Species Act
FCC	Federal Communications Commission
Final EIS	Final EIS
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FMEA	Failure Modes and Effects Analysis
FOS	Factors of Safety
FSH	Forest Service Handbook
FSM	Forest Service Manual
FWP	Montana Fish, Wildlife, and Parks
FY	Fiscal Year
GDE	Ground Water Dependent Ecosystem
GIS	Geographic Information System
gpm	gallons per minute
GPS	Global Positioning System
H&H	Hydraulic and Hydrologic
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAP	Hazardous Air Pollutant
HD	Hunting District
HDPE	high density polyethylene
HE	Habitat Effectiveness
HGM	Hydrogeomorphic
HR	Hayes Ridge
HRMIB	Hard Rock Mining Impact Board
HRV	Historical Range of Variation
HU	Habitat Unit
Hz	hertz
IGBC	Interagency Grizzly Bear Committee
Impact Plan	Hard-Rock Mining Impact Plan
INFS	Inland Native Fish Strategy
IRA	Inventoried Roadless Area
IRIS	Integrated Risk Information System
ISC	Industrial Source Complex
KFP	Kootenai Forest Plan

Acronym	Acronym Description
KNF	Kootenai National Forest
KOP	Key Observation Point
kV	kilovolt
kV/m	1,000 volts per meter
kw	kilowatt
kwh	kilowatt-hour
LAC	Level of Acceptable Change
LAU	Lynx Analysis Units
LCAS	Lynx Conservation Assessment and Strategy
LOC	Levels of Concern
LOS	Level of Service
LWD	Large woody debris
M bcy	million bank cubic yards
MA	Management Area
MAAQS	Montana Ambient Air Quality Standards
MAC Report	Mineral Activity Coordination Report
MAGIC	Model of Acidification of Groundwater in Catchments
MAQP	Montana Air Quality Permit
MBEMP	Montana Bald Eagle Management Plan
MBEWG	Montana Bald Eagle Working Group
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCE	Maximum Credible Earthquake
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFISH	Montana Fisheries Information System
MFSA	Montana Major Facility Siting Act
mG	milligauss
MIS	Management Indicator Species
mmbf	million board feet
MMC	Montanore Minerals Corporation
MMI	Mines Management, Inc.
MMRA	Metal Mine Reclamation Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of Understanding
MP	milepost
MPDES	Montana Pollutant Discharge Elimination System
mph	miles per hour
MW	Megawatt (1,000,000 watts or 1,000 kilowatts)
MWh	Megawatt hour (1,000 kilowatt-hours)
N	nitrogen
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Grave Protection and Repatriation Act
NCDE	Northern Continental Divide Ecosystem
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHPA	National Historic Preservation Act

Acronym	Acronym Description
NO_2	nitrogen dioxide
NOI	Notice of Intent
Noranda	Noranda Minerals Corporation
NRHP	National Register of Historic Places
OG	effective old growth
OHV	Off Highway Vehicle
OLM	Ozone Limiting Method
OMRD	Open Motorized Route Density
ORD	Open Road Density
pcf	pounds per cubic foot
Plum Creek	Plum Creek Timber Company
PM_{10} and $PM_{2.5}$	particulate matter less than 10 and 2.5 microns
PMOA	1997 Programmatic Memorandum of Agreement
PPI	Potential Population Index
PPL	Potential Population Level
PSD	Prevention of Significant Deterioration
PSU	Planning Sub-Unit
RHCA	Riparian Habitat Conservation Area
RMO	Riparian Management Objective
ROD	Record of Decision
ROG	Replacement Old Growth
ROS	Recreation Opportunity Spectrum
SADT	Seasonal Average Daily Traffic
SAG	semi-autogenous grinding
SC	specific conductance
SHPO	State Historic Preservation Office
SOx	Sulfur oxides
SPLP	Synthetic Precipitation Leaching Procedure
SPT	Standard Penetration Test
SWPPP	Storm Water Pollution Prevention Plan
T&E	Threatened and Endangered
TBEL	Technology-Based Effluent Limit
TCP	Traditional Cultural Property
TDS	total dissolved solid
TMDL	Total Maximum Daily Load
TMRD	Total Motorized Route Density
tpd	tons per day
tpy	tons per year
TRB	Transportation Research Board
TSMRS	Timber Stand Management Record System
TSP	total suspended particulate
TSS	total suspended solid
TWSC	Two-Way, Stop Controlled
USDA	U.S. Department of Agriculture
USFWS	USDI Fish and Wildlife Service
USGS	U.S. Geological Survey
V/m	volt per meter
VMS	Visual Management System

Acronym	Acronym Description
VQO	Visual Quality Objective
VRU	Vegetation Response Units
WQBEL	Water Quality-Based Effluent Limit

Chapter 7. Glossary

acid-base potential	A laboratory method to determine the acid-generating potential of sulfide minerals.
adit	A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and dewatered.
alluvium	Soil and rock that is deposited by flowing water.
alteration haloes	Zones of changed mineralogy that occur around the ore deposit, containing chalcopyrite-calcite, pyrite-calcite, and galena-calcite mineralization.
ambient	Surrounding, existing.
anadromous	Fish that spend all or part of their adult life in salt water and return to freshwater streams and rivers to spawn.
aquifer	Rock or sediment which is saturated with water and sufficiently permeable to transmit quantities of water.
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.
authigenic	Pertaining to minerals or materials that grow in place with a rock, rather than having been transported and deposited.
base flow	Base flow is the flow of a perennially flowing stream without any direct surface runoff; such flow is the result of ground water seepage into the stream channel.
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).
Best Management Practices	Structural, non-structural, and managerial techniques that are recognized to be the most effective and practical means to control non-point source pollutants.
bioavailable	The state of a toxicant such that there is increased physicochemical access to the toxicant by an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism.
bioconcentration	Chemicals that increase in living organisms resulting in concentrations greater than those found in the environment.
biodiversity	A term that describes the variety of lifeforms, the ecological role they perform, and the genetic diversity they contain.
blasting	To remove, open, or form by or as if by an explosive.
borrow materials	Soil or rock dug from one location to provide fill at another location.
broadcast seeding	A means of planting where seed is distributed on the ground surface mechanically or by hand.

Candidate species	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.
clastic	Consisting of fragments of rocks that have been removed individually from their places of origin.
colluvial	Rock detritus and soil accumulated at the foot of a slope.
colluvium	Fragments of rock carried and deposited by gravity.
complexation	The formation of complex chemical species.
concentrate	To make less dilute.
confluence	The point where two streams meet.
core grizzly bear habitat	An area of high quality habitat within a Bear Management Unit that is greater than or equal to 0.31 miles from any road (open or restricted), or motorized trail. Core habitat may contain restricted roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth.
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.
Cretaceous	The third and latest of the periods included in the Mesozoic Era. Also, the system of strata deposited in the Cretaceous period and related most commonly to the age of the dinosaurs.
Cumulative Effects Model	Vegetation mapping for the KNF based on 1992 satellite imagery and updated for harvest activities through 1995.
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.
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.
dendritic	The branching of natural drainage systems.
dike	A tabular body of igneous rock that cuts across the structure of adjacent rock units.
dilatant	Increasing in viscosity and setting to a solid as a result of deformation by expansion, pressure, or agitation.
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.
dispersed recreation	Recreation that occurs outside of developed sites in the unroaded and roaded environment (*e.g.*, hunting, backpacking, and berry picking).
downgradient	A direction characterized by lower fluid potential or hydraulic head.
drift	A nearly horizontal mine passageway driven on or parallel to the course of a vein or rock stratum.
drill seeding	A mechanical method for planting seed in soil.
drilling	To bore or drive a hole in.
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. Also see "old growth areas managed by the KNF Forest Plan."
effluent	Waste water discharge.
embeddedness	The degree to which rocks are covered up by the substrate material (sand, clay, silt, etc.).
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 the Interior, in accordance with the Act, identifies or lists the species as "threatened" or "endangered."
ephemeral stream	A stream that flows only as a direct response to rainfall or snowmelt events; having no base flow.
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.
evapotranspiration	The water lost from an area through the combined effects of evaporation from the ground surface and transpiration from the vegetation.
face	The part of an adit or mine that is actively being excavated; the end of the adit being excavated.
facies	A distinctive group of characteristics within part of a rock body (such as composition, grain size, or fossil assemblages) that differ as a group from those found elsewhere in the same rock unit.
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.

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.
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.
freeboard	The height above the recorded high-water mark of a structure (as a dam) associated with the water.
genus	A group of related species used in the classification of organisms (plural = genera).
glacial moraine	Mounds and ridges of broken rock and soil particles deposited by glacial action.
glaciofluvial	Pertaining to the meltwater streams flowing from wasting glacier ice and especially to the deposits and landforms produced by such streams.
glaciolacustrine	Refers to sediments or processes involving a lake that received meltwater from glacial ice.
granodiorite	A rock roughly equivalent to granite, which is formed deep within the earth at high temperatures and pressures.
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.
Hard Rock Mining Impact Plan	An impact plan that identifies the local government services and facilities that will be needed as a result of the mineral development. The developer of each proposed new large-scale hard rock mine in Montana is required to prepare an impact plan.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
home range	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 (waterloving) vegetation. Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.
hydrophytic	A plant that grows either partly or totally submerged in water.

hydrostratigraphic	A body of rock having considerable lateral extent and composing a geologic framework for a reasonably distinct hydrologic system.
hyporheic zone	The subsurface volume of sediment and porous space adjacent to a stream through which water in a stream readily exchanges.
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, gray wolf, bald eagle, peregrine falcon, elk, white-tailed deer, mountain goat, and pileated woodpecker.
interfinger (intertongue(ing))	A boundary that forms distinctive wedges, fingers or tongues between two different rock types
interim reclamation	Reclamation conducted during operations to reduce erosion, sedimentation, noxious weed invasion, and visual impacts. The reclamation may or may not be redisturbed at mine closure.
intermittent stream	A stream that does not flow continuously from its source to the mouth, at least for a portion of the year
intervisible	Mutually visible, or in sight, the one from the other, as stations.
intervisible turnout	An area designed to allow vehicles to pass and so spaced to provide visibility between the turnouts.
joint	Fracture in rock, generally more or less vertical or transverse.
kilovolt	One kilovolt equals 1,000 volts
kilowatt	One kilowatt equals 1,000 watts
kilowatt-hour	One kilowatt of power supplied to or taken from an electrical circuit for one hour
land application disposal	A method of disposing of 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.
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.
lithologic (lithology)	The character of a rock formation.
loading	Pertaining to the contribution of material or chemicals to a receiving stream.
loess	Wind blown soil deposits.
long term	A period greater than the life of the mine (*i.e.*, post closure).
macroinvertebrate	Small animals without backbones that are visible without a microscope, for example, insects, small crustaceans, and worms.
macrophytes	Plants visible to the unaided eye. In terms of plants found in wetlands, macrophytes are the conspicuous multicellular plants.
mainstem	The primary channel in a stream or river.

make-up 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 indicator species	Any species, group of species, or species habitat element selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity.
management situations	Areas of grizzly bear or mountain goat habitat that due to their characteristics, have specific Forest Service management goals and directions.
maximum modification VQO	Management activities may be dominant, but appear natural when seen as background.
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.
mesothelioma	Form of cancer that is almost always caused by previous exposure to asbestos.
metapopulation	Multiple populations of an organism within an area in which interbreeding could occur, but does not due to geographic barriers.
metasedimentary	A rock type that is composed of formerly small-sized particles ("sedimentary," like the grains of sands on lakeshores) that are then exposed to high pressures and temperatures and become compacted into solid stone and are altered chemically.
metric	A value calculated from existing data and used for summarization purposes.
microseismic	A feeble rhythmically and persistently recurring earth tremor.
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.
mixing zone	A limited area of a surface water body or a portion of an aquifer, where initial dilution of a discharge takes place and where water quality changes may occur and where certain water quality standards may be exceeded.
modification VQO	Management activities in foreground and middle-ground may be dominant, but appear natural.
montane	Pertaining to mountainous regions.
monzonite	An intermediate igneous intrusive rock composed of approximately equal amounts of sodic to feldspars
moving windows	**A** technique for measuring road densities on a landscape using a computerized Geographic Information System (GIS). The results are displayed as a percent of the analysis area in relevant route density classes.
mucking	To move or load muck.
mycorrhizae	Fungus root and the association, usually symbiotic, of specific fungi with the roots of higher plants.

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.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities.
old growth areas managed by the KFP	Areas are managed as MA 13. The goal of MA 13 is to maintain 10 percent on National Forest System lands below 5,500 feet within a major drainage in old growth condition. The KFP 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. Also see "effective old growth."
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" 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.
ore	A naturally occurring mineral containing a valuable constituent for which it is mined and worked.
overburden	Geologic material of any nature that overlies a deposit of ore or coal.
palustrine system wetland	Palustrine system wetlands are traditionally called marshes, swamps, bogs, or fens. They include all non-tidal 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 0.5 percent.
partial retention VQO	Management activities remain visually subordinate.
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.
perennial stream	A stream that flows throughout the year, and from source to mouth.
periphyton	Organisms (as some algae) that live attached to underwater surfaces.
permeable	Allowing the passage of fluids.

permeameter	Device used to measure the permeability of soil, sediment or rock. Permeability is the capacity of a porous rock, sediment or soil to transmit a fluid.
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.
planning sub-unit	An analysis area based on watersheds to be used for certain wildlife species in the Forest Plan and NEPA analysis.
planning unit	A geographic area based on sub-basins or fourth level hydrologic units, as recognized by the U.S. Geological Survey, used by the Forest Service for natural resources planning.
Pleistocene	The first epoch of the Quarternary Period in the Cenozoic Era with respect to the age of the earth. Characterized by the spreading and recession of the ice sheets, and by the appearance of modern man.
population	A collection of individuals that share a common gene pool. In this document, local population refers to those breeding individuals within the analysis area.
portal	Surface entrance to a mine, particularly to a tunnel or adit.
Precambrian	All rocks formed before Cambrian time.
preservation VQO	Only ecological or minimal changes permitted.
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 rock that has formed as a result of the hardening of sediments by pressure and heat. A granular metamorphic rock consisting essentially of sand-sized particles and 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 streamflows in a short time frame.
raise	A vertical underground tunnel.
raise	Incremental increases in the height of a dam.
reach	An extended portion of river with uniform characteristics.
reagents	A substance used (as in detecting or measuring a component, in preparing a product, or in developing photographs) because of its chemical or biological activity.
reclamation	The concept of reclamation of land has been defined as including all desirable and practical methods for: (a) designing and conducting a surface disturbance in a manner that minimizes the effect of the disturbance and enhances the reclamation potential of the disturbed lands; (b) handling surficial material in a manner that ensures a root zone that is conducive to the support of plant growth where required for future use; and contouring the surface to minimize hazardous conditions, to ensure stability, and to protect the surface against wind or water erosion.
redd	A fish spawning nest.

regeneration	Regrowth of a tree crop, or other vegetation, whether by natural or artificial means.
regeneration harvest	Removal of an existing stand to prepare the site for regeneration. Clearcut, shelterwood and seed tree harvests are examples of regeneration treatments.
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.
resistivity	The thermal resistance of unit area of a material of unit thickness to heat flow caused by a temperature difference across the material. (m^2K/W)
retention VQO	Management activities are not visually evident to the casual observer.
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.
ripped	To tear, split apart, or open.
riprap	A foundation or sustaining wall of stones or chunks of concrete thrown together without order to prevent erosion.
rock fragment	Rock that is larger than 2 millimeters (about 1/16 inch) in diameter.
salmonid	Member of the fish family Salmonidae; includes salmon and trout.
sedge	A grass-like plant, often associated with moist or wet environments.
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.
short term	A period of time less than 35 years (*i.e.*, operational period).
side slope	The slope of an embankment or waste dump.
siltite	A hard, metamorphic rock, intermediate between shale and slate, was originally silts.
slimes	A product of wet crushing consisting of wet particles that will pass a 200-mesh screen.
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.
soil erodibility	A measure of the inherent susceptibility of a soil to erosion, without regard to topography, vegetation cover, management, or weather conditions.

sorb	Remove solutes from the fluid phase and concentrate them on the solid phase of a medium either by absorption or adsorption.
stability	The ability of a population to remain at about the same population size over time through stable natality and mortality rates.
piezometer	A small well used to locate the water table.
starter dam	Earthen dams built of borrow material to initiate construction of the tailings impoundment.
stope	Step-like underground excavation for removal of ore in successive layers.
stratabound	A mineral deposit confined to a single stratigraphic unit.
stratigraphy	The arrangement of strata.
stratum	A section of a formation that consists of primarily the same rock type.
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.
syncline	A sharply arched fold of stratified rock from whose central axis the strata slope upward in opposite directions: opposed to anticline.
tackifier	An agent that binds seed, fertilizer, and mulch to a site, often used when seeding slopes.
taxon	Any formal taxonomic group such as genus, species, or variety.
Tertiary	The earlier of two geologic periods comprised in the Cenozoic Era, in the classification generally used. Also, the system of strata deposited during that time period.
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.
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.
unconsolidated	Loose or soft.
upgradient	A direction characterized by higher fluid potential or hydraulic head.
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.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.
visual absorption level	A classification used in the Forest Service Scenery Management System to denote the relative ability of a landscape to accept human alterations without loss of character of scenic quality.

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.
waste rock	Rock that does not contain a valuable constituent at concentrations suitable for mining.
waterbars	A shallow ditch dug across a road at an angle to prevent excessive flow down the road surface and erosion of road surface materials.
waters of the U.S.	Waters that include the following: all interstate waters; intrastate waters used in interstate and/or foreign commerce; tributaries of the above; territorial seas at the cyclical high tide mark; and wetlands adjacent to all the above.
wetlands	Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
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 8. References

Adamus, PP.R., E.J. Stockwell, M.E. Clairain, Jr., L.PP. Morrow, R.D. Rozas, and R.D. Spith. 1991. Wetland Evaluation Technique (WET). Volume I. Literature review and evaluation rationale. U.S. Army Corps of Engineers, Waterways Experiment Station. Wetlands Research Program, Technical Report WRP-DE-2.

Agapito Associates, Inc. 2007a. Evaluation of Alternative Plant Sites in Libby Creek, Montanore Project, Lincoln County, Montana. Prepared for ERO Resources Corporation. On file with the KNF and the DEQ. pp. 7.

Agapito Associates, Inc. 2007b. Evaluation of Subsidence Potential Montanore Project. Prepared for ERO Resources Corporation. On file with the KNF and the DEQ. pp. 32.

Agapito Associates, Inc. 2008. Backfilling Pre-Feasibility Study, Montanore Project. Prepared for ERO Resources Corporation. On file with the KNF and the DEQ. pp. 18.

Apps, C.D. 2000. Space-use, diet, demographics, and topographic associations of lynx in the southern Canadian Rocky Mountains: a study. Pp. 351-371. *In* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (tech. eds.). Ecology and conservation of lynx in the United States. University Press of Colorado. Boulder, CO. 480 pp.

Asher Sheppard Consulting. 2007. Electric and magnetic fields of electric power transmission lines and substations: public health issues and analysis of Montanore Project alternatives. Submitted to the KNF and the DEQ. pp. 35.

Askins, R. A. 2000. Restoring North America's Birds: Lessons from Landscape Ecology. Yale University Press. 319 pp.

Austin, M. 1998. Wolverine winter travel routes and response to transportation corridors in Kicking Horse Pass between Yoho and Banff National Parks. M.S. thesis, University of Calgary, Alberta, Canada. 40 pp.

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electric Institute and the Raptor Research Foundation. Washington, DC.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, CA.

Avista Corporation. 2007. 2006 Annual Report Implementation of PM and E Measures. The Clark Fork Project, FERC Project Number 2058. Spokane, WA.

Bain, M.B. and N.J. Stevenson, editors. 1999. Aquatic Habitat Assessment: Common Methods. American Fisheries Society. Bethesda, MD.

Banci, V. 1994. Wolverine. Chapter 5 *In* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski. (tech. eds.). The Scientific Basis for Conserving Forest Carnivores American Marten, Fisher, Lynx and Wolverine in the Western United States. General Technical Report RM-254. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 184 pp.

Barbour, M.T., J. Gerritsen, B.D. Synder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, 2nd Edition. EPA 841-B-99-002. EPA, Office of Water. Washington, DC.

Bartelt, P.E. and C.R. Peterson. 1994. Riparian habitat utilization by western toads (*Bufo boreas*) and spotted frogs (*Rana pretiosa*) on the Targhee National Forest. Final Report, July 11. Department of Biological Sciences, Idaho State University, and Idaho Museum of Natural History.

Bate, L.J. and M.J. Wisdom. 2004. DRAFT – Snag, large tree and log resources in relation to roads and other indices of human access on the Flathead National Forest. Progress Report July 2002. 31 pp.

Baty, G.R. 1995. Resource partitioning and browse use by sympatric elk, mule deer and white-tailed deer on a winter range in western Montana. M.S. thesis, University of Montana. Missoula, MT. 228 pp.

Belt, G.H., J. O'Laughlin, and T. Merrill. 1992. Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature. Idaho Forest, Wildlife and Range Policy Analysis Group Report Number 8. University of Idaho.

Bennett, E.H. 1984. A hypothesis concerning the genesis of orebodies in the Coeur d'Alene Mining District, Idaho. Idaho Geological Survey Technical Report 84-7, pp. 39.

Berkman, H.W. and C.F. Rabeni. 1987. Effect of siltation on stream fish communities. Environmental Biology of Fishes 18(4):285-294.

Bernall, S. and L. Lockard. 2008. Upstream Fish Passage Studies Annual Progress Report - 2007, Fish Passage / Native Salmonid Program, Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, Montana and Avista Corporation, Noxon, Montana (in preparation).

Beuhler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seeger. 1991. Effects of human activity on bald eagle distribution on the Northern Chesapeake Bay. Journal of Wildlife Management 55:282-290.

Big Sky Acoustics. 2006. Revised Montanore Project Environmental Noise Study. Submitted to the KNF and the DEQ. pp. 14 plus figures and appendices.

Bjornn, T.C., C.A. Peery, and L.M. Garmann. 1998. Deposition of fine sediments in substrates and their effect on survival of trout embryos. Technical Report 98-1. Completion Report Project INT-91609-RJVA. Prepared for Rocky Mountain Research Station. Idaho Cooperative Fish and Wildlife Research Unit. Moscow, ID.

Board of Health and Environmental Sciences. 1992. Order adopting the Montana Department of Health and Environmental Sciences' recommendation to permit a change in the quality of ambient waters. On file with the DEQ.

Boleneus, D.E., L.M. Appelgate, J.H. Stewart, and M.L. Zientek. 2005. Stratabound Copper-Silver Deposits of the Mesoproteozoic Revett Formation, Montana and Idaho. USGS Scientific Investigation Report 2005-5231.

Boleneus, D.E., L.M. Applegate, N.L. Joseph, and T.R. Brandt. 2001. Raster images of geologic maps of middle Proterozoic belt strata in parts of Benewah, Bonner, Kootenai, and Shoshone counties, ID; and Lincoln, Mineral, and Sanders counties, MT: USGS Open-File Report, 01-0438. pp. 38.

Bonneville Power Administration. 2006. Final System Impact Study, Montanore Mine Project Load, Flathead Electric Cooperative, Inc. Network Planning, BPA. Submitted to the KNF and the DEQ. pp. 10 plus appendices.

Bonneville Power Administration. 2008. Sedlak Park Wetlands Identification. Email correspondence from Gene Lynard. Submitted to the KNF and the DEQ.

Boore, D.M., W.B. Joyner, and T.E. Fumal. 1997. Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Work, Seismological Research Letters 68(1):128-153.

Brandborg, S.M. 1955. Life history and management of the mountain goat in Idaho. Wildlife Bulletin No. 2. Idaho Department of Fish and Game. Boise, ID. 142 pp.

Bratkovich, A. 2006. Wildlife Biologist, KNF. Personal communication with Karen Baud, Wildlife Biologist, ERO Resources Corporation. KNF, Project Record, Montanore Project. February 16.

Bratkovich, A. 2008. Wildlife Biologist, KNF. Information provided to ERO Resources Corporation in comment on internal draft document. KNF, Project Record, Montanore Project. August 7.

Brinson, M. 1993. A Hydrogeomorphic Classification for Wetlands. Wetlands Research Program Technical Report WRP-DE-4. US Army Corps of Engineers. pp 79.

Brown, J. 2005. Montana Fish, Wildlife, and Parks. Personal communication with A. Bratkovich, Wildlife Biologist, KNF.

Brown, J. 2007. Montana Fish, Wildlife, and Parks. Personal communication with K. Baud, Wildlife Biologist, ERO Resources Corporation. September 21.

Brown, J. 2008. Montana Fish, Wildlife, and Parks. Personal communication with K. Baud, Wildlife Biologist, ERO Resources Corporation. April 30, September 11, and September 15.

Bull, E.L. 1975. Habitat utilization of the pileated woodpecker, Blue Mountains, Oregon. M.S. thesis, Oregon State University. Corvallis, OR.

Bull, E.L. 1980. Resource partitioning among woodpeckers in northeastern Oregon. Ph.D. dissertation, University of Idaho. Moscow, ID.

Bull, E.L. 1987. Ecology of the pileated woodpecker in northeastern Oregon. Journal of Wildlife Management, 51 (2): 472-481.

Bull, E. L., A. L. Wright, and M. G. Henjum. 1990. Nesting habitat of Flammulated Owls in Oregon. Journal of Raptor Research 24: 52-55.

Bull, E.L., R.C. Beckwith, and R.S. Holthausen. 1992a. Arthropod diet of pileated woodpeckers in northeastern Oregon. Northwestern Naturalist 73 (2): 42-45.

Bull, E.L., R.S. Holthausen, and M.G. Henjum. 1992b. Roost trees used by pileated woodpeckers in northeastern Oregon. Journal of Wildlife Management 56 (4): 786-793.

Bull, E.L. and R.S. Holthausen. 1993. Habitat use and management of pileated woodpeckers in northeastern Oregon. Journal of Wildlife Management. 57: 335-345.

Bull, E. L., and J. E. Jackson. 1995. Pileated Woodpecker (*Dryocopus pileatus*). In *The Birds of North America, No. 148* (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA. and The American Ornithologists' Union, Washington, D.C.

Bull, E.L. and E.C. Meslow. 1977. Habitat requirements of the pileated woodpecker in northeastern Oregon. Journal of Forestry, 75 (6): 335-337.

Bull, E.L., A.D. Twombly, and T.M. Quigley. 1980. Perpetuating snags in managed mixed conifer forests of the Blue Mountains, Oregon. pp. 325-334. *Management of western forests and grasslands for nongame birds*, R. M. DeGraaf (tech. coordinator), USDA Forest Service, Intermountain Forest and Range Experiment Station, INT-GTR-86. Ogden, UT.

Bureau of Reclamation. 1977. Design of Small Dams. USGPO, 1973/1977, revised reprint of 2nd edition.

Bury, R.B. 1983. What we know and do not know about off-road vehicle impacts on wildlife. In R.N.L. Andrews & P.P. Nowak (eds.) Off-road vehicle use: A management challenge conference. Washington, DC. pp. 110-122.

Buskirk, S.W., L.F. Ruggiero, and C.J. Krebs. 2000. Habitat fragmentation and interspecific competition: implications for lynx conservation. pp. 83-100. *In* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (tech. eds.). Ecology and conservation of lynx in the United States. University Press of Colorado. Boulder, CO. 480 pp.

Buterbaugh, G.L. 1991. Biological Opinion on the effects to grizzly bears and grey wolf from the implementation of proposed timber harvest in the Grouse Keeler Timber Sale (Compartment 40), KNF. Libby, MT. USDI Fish and Wildlife Service. Denver, CO. July 22.

Butts, T.W. 1992. Wolverine (*Gulo gulo*) Biology and Management: A literature review and annotated bibliography. USDA Forest Service, Region 1, Missoula, MT. 106 pp. plus attachments.

Call & Nicholas, Inc. 2005a. Reevaluation of room-and-pillar mining layout at Rock Lake. Memorandum to McIntosh Engineering. Submitted to the KNF and the DEQ. pp. 6.

Call & Nicholas, Inc. 2005b. Troy Sinkhole Evaluation. Memorandum to Genesis Troy Mine, July 28. Submitted to the KNF and the DEQ. pp. 17.

Call & Nicholas, Inc. 2006. Montanore subsidence evaluation. Memorandum to McIntosh Engineering. Submitted to the KNF and the DEQ. pp. 8.

Camp, Dresser, and McKee. 1991. Final Report: Soil Attenuation and Tailing Water Quality, Montanore Project. Report prepared for Noranda Minerals Corporation. August.

Casebeer, R.L., M.J. Rognrud and S. Brandborg. 1950. Rocky Mountain goat in Montana. Montana Fish and Game Commission, Wildlife Restoration Division. Pittman-Robertson Federal Aid Project Bulletin No. 5. 107 pp.

Cassirer, E.F., C.R. Groves, and D.L. Genter. 1994. Coeur d'Alene salamander Conservation Assessment. USDA Forest Service, Region 1. Missoula, MT. 55 pp.

Castaneda, B. 2004. Old Growth Management. 1900/2600 letter, April 26, 2004. USDA Forest Service, KNF, Libby, MT. 1 pg. + 61 pp attachment: "KNF Considerations for the Management of Old-Growth."

Chadwick Ecological Consultants, Inc. 2000. Fisheries survey of the Bull River Drainage, Montana. Prepared for Avista Corporation. Spokane, WA.

Chen, J., J.F. Franklin and T.A. Spies. 1995. Growing-season microclimatic gradients from regeneration harvest edges into old-growth Douglas-fir forests. Ecological Applications, Volume 5, Number 1 74-86.

Chen-Northern, Inc. 1989. Water resources baseline inventory, Montana Project. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix B.

Chen-Northern, Inc. 1990. Interim monitoring program, water resources summary report, April 1989 through February 1990. Submitted to the Montana Department of State Lands.

Chen-Northern, Inc. 1991. 1990 Interim water resources monitoring program, summary report, April 1990 through February 1991. Submitted to the Montana Department of State Lands.

Chen-Northern, Inc. 1992. 1991 Interim water resources monitoring program, summary report, April 1991 through February 1992. Submitted to the Montana Department of State Lands.

Chen-Northern, Inc. 1993. 1992 Water resources monitoring program, summary report, April 1992 through October 1992. Submitted to the Montana Department of State Lands.

Cherry, M.B. 1997 (unpublished). The Black-backed and Three-toed Woodpeckers: Life History, Habitat Use, and Monitoring Plan. Gallatin National Forest. Bozeman, MT. 22 pp.

Christensen, A.G. and M.J. Madel. 1982. Cumulative effects analysis process – Grizzly bear habitat component mapping. KNF. Libby, MT. 38 pp.

Christy, R.E., and S.D. West. 1993. Biology of bats in Douglas-fir forests. USDA Forest Service. Pacific Northwest Research Station. General Technical Report. PNW-GTR 308. 28 pp.

Claar, J.J., N. Anderson, D. Boyd, M. Cherry, B. Conard, R. Hompesch, S. Miller, G. Olson, H. Ihsle Pac, J. Waller, T. Wittinger, and H. Youmans. 1999. Carnivores. Pages 7.1-7.63 *In* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of the Wildlife Society. 307 pp.

Clark, J.R. 2000. Endangered and Threatened Wildlife and Plants: Determination of Threatened Status for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Related Rule; Final Rule. USDI Fish and Wildlife Service. *Federal Register*, March 24. Vol. 65:58. pp 16051-16086.

Clark, A.L. 1971. Strata-Bound Copper Sulfides in the Precambrian Belt Supergroup, Northern Idaho and Northwestern Montana, Society Mining Geology Japan, Special. Issue 3, 261-267, in International Mineralogical Association International Association on the Genesis of Ore Deposits (IMA-IAGOD) Meetings 1970, IAGOD Vol. 1.

Cook, J.G., L.L. Irwin, L.D. Bryant, R.A. Riggs, and J.W. Thomas. 1998. Relations of forest cover and condition of elk: a test of the thermal cover hypothesis in summer and winter. Wildlife Monographs 141.

Copeland, J.P. 1996. Biology of the wolverine in central Idaho. M.S. thesis, University of Idaho. 138 pp.

Corn, P., P. Hendricks, T. Koch, B. Maxell, C. Peterson, and K. Werner. 1998. Unpublished letter to Forest Service Region 1 Species at Risk Task Group: subject – Boreal toad (*Bufo boreas boreas*) listing as a sensitive species for all Region 1 Forests. 8 pp.

Council of Environmental Quality. 1997. Environmental Justice, Guidance under the National Environmental Policy Act. Available at: <http://ceq.eh.doe.gov/nepa/regs/ej/justice.pdf>.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 131pp.

Davidson, J. 1987. Ground Stability Investigation, Troy Mine–(ID No. 24-01467). MSHA Safety and Health Technology Center, Ground Support Division. Denver, CO. November 17. 7 pp.

deMaynadier, P.G., and M.L. Hunter, Jr. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. Conservation Biology 12(2):340-352.

Department of Environmental Quality. 1996. Geochemical comparison of two very similar stratabound copper sulfide orebodies in Northwest Montana, DEQ Geochemical Report for ASARCO Rock Creek Project.

Department of Environmental Quality. 1997. Authorization to discharge under the Montana pollutant discharge elimination system (MPDES). On file with the DEQ. pp. 20.

Department of Environmental Quality. 2006. Preliminary determination-air quality permit. pp. 38. Available at: http://www.deq.state.mt.us/AirQuality/ARM_Permits/3788-00.pdf.

Department of Environmental Quality. 2007. State of Montana Modeling Guideline for Air Quality Permit Applications. Available at: www.deq.state.mt.us/AirQuality/Montana%20Modeling%20Guideline%20for%20Air%20Quality%20Permits%20(3).pdf

Department of Environmental Quality. 2008a. Circular DEQ-7: Montana Numeric Water Quality Standards. Available at: www.deq.state.mt.us/wqinfo/Standards/CompiledDEQ-7.pdf.

Department of Environmental Quality. 2008b. Recently collected water quality data from Troy Mine, Lincoln County, MT. Laboratory data and discussion from Wayne Jepson to Barbara Galloway at ERO Resources Corporation. October.

Department of Natural Resources and Conservation (DNRC). 1993. Certificate of Environmental Compatibility and Public Need, Montanore Project. On file with the DEQ.

Department of Natural Resources and Conservation (DNRC). 2008. Information and Instructions for Application for Beneficial Water Use Permit. Form No. 600 and Criteria Addendum A. Water Rights Division, Water Rights Bureau. Available at: <http://dnrc.mt.gov/wrd/water_rts/wr_general_info/wrforms/600-ins.pdf>.

Department of State Lands. 1992. Record of Decision, Montanore Project. On file with the DEQ.

Department of State Lands. 1993. Montanore Operating Permit #00150. On file with the DEQ. pp. 30.

Dood, A.R., S.J. Atkinson, and V.J. Boccadori. 2006. Grizzly Bear Management Plan for western Montana: Final Programmatic Environmental Impact Statement 2006-2016. Montana Fish, Wildlife, and Parks. Helena, MT. pp. 163.

Dunnigan, J., B. Marotz, J. DeShazer, L. Garrow, and T. Ostowski. 2003. Mitigation for the Construction and Operation of Libby Dam, Annual Report, 2001-2002, Montana Fish, Wildlife, and Parks. Project Number 199500400, Agreement DE-A179-83-BP12660. Funded by Bonneville Power Administration. June.

Dunnigan, J., J. DeShazer, L. Garrow, T. Ostowski, and B. Marotz. 2004. Mitigation for the Construction and Operation of Libby Dam, Annual Report 2003. Project Number 199500400, Agreement DE-A179-83-BP12660. Montana Fish, Wildlife and Parks. Funded by Bonneville Power Administration. June.

Dunnigan, J., J. DeShazer, L. Garrow, T. Ostowski, and B. Marotz. 2005. Mitigation for the Construction and Operation of Libby Dam, 2004-2005 Annual Report. Project Number 199500400. Funded by Bonneville Power Administration. pp. 148. June.

Edwards, M. 2005. Ranger, KNF. Personal communication with Julia Grant, Natural Resource Specialist, ERO Resources Corporation. October 24 and 25. KNF, Project Record, Montanore Project.

Eisler, R. 2000. Handbook of Chemical Risk Assessment Health Hazards to Humans, Plants, and Animals. Volume 1 Metals. Lewis Publishers, Boca Raton, FL. pp. 652-675.

Electric Power Research Institute. 2006. T&D System Design and Construction for Enhanced Reliability and Power Quality. Report No. 1010192. Palo Alto, CA.

Enviromin. 2007. Summary of Geochemical Data for the Rock Creek-Montanore Stratabound Cu-Ag Deposit. Technical Report submitted to ERO Resources Corporation. Submitted to the KNF and the DEQ. pp. 42.

Environmental Laboratory. 1987. Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

Environmental Protection Agency. 1993. Applicability of 40 CFR 440 Effluent Limitations Guidelines to discharges from active ore (metal) mining and dressing sites. On file with the DEQ.

Environmental Protection Agency. 1996. 1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water. EPA-820-B-96-001. Office of Water. Washington, DC.

Environmental Protection Agency. 1998. Final Guidance for Consideration of Environmental Justice in EPA's NEPA Compliance Analyses. Washington, DC. Available at: <www.epa.gov/oecaerth/resources/policies/ej/ej_guidance_nepa_epa0498.pdf >.

Environmental Protection Agency. 1999. Final Guidance for Consideration of Environmental Justice in Clean Air Act 309 Reviews. Washington, DC. Available at: <http://www.epa.gov/compliance/resources/policies/nepa/enviro_justice_309review.pdf>.

Environmental Protection Agency. 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Stream in Nutrient Ecoregion II. EPA-822-B-00-015. Office of Water. Washington, DC.

Environmental Protection Agency. 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. EPA-823-R-01-001. Office of Water. Office of Science and Technology. Washington, DC.

Environmental Protection Agency. 2002. Wastewater Technology Fact Sheet: Slow Rate Land Treatment. Office of Water. EPA 832-F-02-012. September 2002. pp. 2.

Environmental Protection Agency. 2006a. National Ambient Air Quality Standards (NAAQS). Available at: <www.epa.gov/air/criteria.html>.

Environmental Protection Agency. 2006b. Process design manual: land treatment of municipal wastewater effluents. EPA/625/R-06/016.

Environmental Protection Agency. 2007. Aquatic Life Ambient Freshwater Quality Criteria-Copper. 2007 Revision. EPA -822-R-07-001. Office of Water. Washington, DC.

ERO Resources Corporation. 2005. Scoping report, Montanore Project EIS. Submitted to the KNF and the DEQ. pp. 9 plus appendices.

ERO Resources Corporation. 2006a. Issue statements and analysis guidance. Submitted to the KNF and the DEQ. pp. 43.

ERO Resources Corporation. 2006b. Transmission line screening analysis report, Montanore Project EIS. Submitted to the KNF and the DEQ. pp. 15 plus figures and appendices.

ERO Resources Corporation. 2007. Make-up water well locations. Submitted to the KNF and the DEQ. pp. 5.

ERO Resources Corporation. 2008a. Montanore tailings impoundment watershed analysis. pp. 6 plus figures.

ERO Resources Corporation. 2008b. Hydrogeology Technical Report, Montanore Mine Area. Submitted to the KNF and the DEQ. pp. 41 plus appendices.

Federal Land Managers' Air Quality Related Values Workgroup. 2000. Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report. USDA Forest Service-Air Quality Program, USDI National Park Service-Air Resources Division, USDI Fish and Wildlife Service-Air Quality Branch. December.

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(4):133-143.

Frederick, G.P. 1991. Effects of forest roads on grizzly bears, elk and gray wolves: a literature review. USDA Forest Service, Kootenai NF. Libby, MT. 53 pp.

Galloway, M. 1977. Qualitative Hydrogeologic Model of Thermal Springs in Fractured Crystalline Rock. M.S. thesis. Montana State University, Bozeman, MT. pp. 197.

GEI Consultants, Inc. 2005. Lower Clark Fork River drainage habitat problem assessment. Report to Avista Corporation, Spokane, Washington.

Genesis Inc. 2000. Benthic Macroinvertebrate and Stream Monitoring Program for Streams Adjacent to Genesis's Troy, Montana Unit. Completion Report for October 2000.

Genesis Inc. 2001. Benthic Macroinvertebrate and Stream Monitoring Program for Streams Adjacent to Genesis's Troy, Montana Unit. Completion Reports for Spring and Fall 2001.

Geomatrix Consultants, Inc. 2006a. Water resources report for CMW Area, Montanore Mine Project. Submitted to the KNF and the DEQ. pp. 37 plus appendices.

Geomatrix Consultants, Inc. 2006b. Analysis of conceptual tailings impoundment diversion drainage alternatives, Montanore Mine Project. Submitted to the KNF and the DEQ. pp. 41 plus appendices.

Geomatrix Consultants, Inc. 2006c. Hydrogeology report, Montanore Mine Project. Submitted to the KNF and the DEQ. pp. 58 plus appendices.

Geomatrix Consultants, Inc. 2006d. Water resources report for baseline conditions, Montanore Mine Project. Submitted to Mines Management, Inc. pp. 82 plus appendices.

Geomatrix Consultants, Inc. 2007a. Supporting water resources information for MPDES permit application, Montanore Mine Project. Submitted to the KNF and the DEQ. pp. 126 plus appendices.

Geomatrix Consultants, Inc. 2007b. Waste rock management plan, Montanore Mine Project. Submitted to the KNF and the DEQ. pp. 19 plus appendices.

Geomatrix Consultants, Inc. 2007c. Evaluation of predicted ground water inflow rates to adits and underground mine workings for Montanore Mine Site. Memorandum to Michael Galloway, Senior Hydrogeologist, ERO Resources Corporation. Submitted to the KNF and the DEQ.

Geomatrix Consultants, Inc. 2007d. Geomatrix conceptual model of ground water flow for the Montanore mine site ground water model. Memorandum to Michael Galloway, Senior Hydrogeologist, ERO Resources Corporation. Submitted to the KNF and the DEQ.

Geomatrix Consultants, Inc. 2007e. Survey of wetlands, sensitive plants, and amphibian/reptiles in alternative sites for tailings impoundment, plant facility and mine tunnel, Montanore Mine Project. Prepared for Montanore Minerals Corp. Submitted to the KNF and the DEQ. pp.15 plus appendices.

Geomatrix Consultants, Inc. 2007f. Water Quality Database, Montanore Mine Project. Prepared for Montanore Minerals Corp. Submitted to the KNF and the DEQ.

Geomatrix Consultants, Inc. 2008a. Revised water balance for “steady-state” mine and adit inflow conditions, Montanore Project. Memorandum to Eric Klepfer (MMC). Submitted to the KNF and the DEQ. pp 4.

Geomatrix Consultants, Inc. 2008b. Groundwater flux calculations at LAD Areas, Montanore Mine Site. Memorandum to Eric Klepfer (MMC). Submitted to the KNF and the DEQ. pp 4.

Geomatrix Consultants, Inc. 2008c. Functional analysis for wetlands in proposed mitigation sites, Montanore Mine Project, Montana. Memorandum to Eric Klepfer (MMC). Submitted to the KNF and the DEQ. pp. 8.

Geomatrix Consultants, Inc. 2008d. Waters of the U.S. Delineation for Little Cherry Creek Tailings Impoundment and Creek Diversion, Montanore Mine Project, Montana. Prepared for Montanore Minerals Corp. Submitted to the KNF and the DEQ. pp. 32 plus appendices.

Georgia Department of Natural Resources. 2006. Guidelines for Slow-Rate Land Treatment of Wastewater. Environmental Protection Division, Watershed Protection Branch, Atlanta, Georgia. June. pp. 58.

Gibson, R. 1948. Geology and ore deposits of the Libby quadrangle, Montana, with sections on Pleistocene glaciation by W.C. Alden and Physiography by J.T. Pardee: U.S. Geological Survey Bulletin 956. pp. 131.

Glasgow Engineering Group, Inc. 2008. Montanore EIS, Alternative 3 Tailings Site (Poorman Creek), Feasibility Stability Evaluation. Letter report to ERO Resources Corporation.

Golder Associates. 1996. Evaluation of surface paste placement as an alternative tailings management strategy. Report prepared for ASARCO, Inc. Submitted to the KNF and the DEQ.

Graham, R.T., A.E. Harvey, M.F. Jurgensen, T.B. Jain, J.R. Tonn, and D.S. Page-Dumroese. 1994. Managing coarse woody debris in forests of the Rocky Mountains. Research Paper INT-RP-477. Ogden, UT. USDA Forest Service Intermountain Research Station. 12 pp.

Grant, G.E., B. Wemple, and F. Swanson (tech. eds.). 1998. Forest Service Roads: A synthesis of scientific information (DRAFT). Pacific NW Research Station. Corvallis, OR.

Green, P.P., J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann. 1992. Old-Growth Forest Types of the Northern Region (errata corrected 2005). USDA Forest Service, Region 1, Missoula, MT.

Grindal, S.D. 1995. Habitat use by bats in fragmented forest. pp. 260-272 in: Bats and Forests Symposium. R. Barclay and R. Brigham Eds. British Columbia Ministry of Forests, Victoria, B.C. 291 pp.

Gurrieri, J. 2001. Hydrology and chemistry of wilderness lakes and evaluation of impacts from proposed underground mining, CMW, Montana. Montana DEQ, Helena, MT. pp. 57 plus appendix.

Gurrieri, J. 2007. Regional geologist, USDA Forest Service, Intermountain Region, Ogden, Utah. Personal communication with Michael Galloway, senior hydrogeologist, regarding ground water storage in surficial deposits in upper portion of drainages. ERO Resources Corporation. September.

Gurrieri, J. 2008. Regional geologist, USDA Forest Service, Intermountain Region, Ogden, Utah. Personal communication with Barbara Galloway, senior hydrologist, regarding fluctuation of St. Paul Lake water levels. ERO Resources Corporation. January.

Gurrieri, J. and G. Furniss. 2004. Estimation of Groundwater Exchange in Alpine Lakes using Non-Steady Mass-Balance Methods. Journal of Hydrology Number 297. pp. 187-208.

Harestad, A.S. and D.G. Keisker. 1989. Nest tree use by primary cavity-nesting birds in south central British Columbia. Canadian Journal of Zoology 67 (4): 1067-1073.

Hargrave, P.A., A.R. English, M.D. Kerschen, G.W. Liva, J.D. Lonn, J.P. Madison, J.J. Metesh, R. Wintergerst. 1999. Abandoned-Inactive Mines of the Kootenai National Forest-Administered Land. Montana Bureau of Mines and Geology. Open File Report MBMG 395. Prepared for the USDA Forest Service Region 1.

Harms, D. 1990. Summary of Interagency biologist meeting of February 22, 1990: Grizzly bear standards and guidelines. Unpublished meeting notes. USDI Fish and Wildlife Service. Helena, MT. 20 pp.

Harris, L.D. 1984. The Fragmented Forest: Island Biogeography Theory and the Preservation of Biotic Diversity. University of Chicago Press, Chicago, IL. pp. 234.

Harris, R.B. 1984. Harvest age structure as an indicator of grizzly bear population status. M.S. thesis, University of Montana, Missoula, MT. 204 pp.

Harrison, J.E. 1972. Precambrian Belt Basin of Northwestern United States: Its Geometry, Sedimentation, and Copper Occurrence. Geological Society of America Bulletin, v. 83. pp. 1215-1240.

Harrison, J.E., E.R. Cressman, and J.W. Wipple. 1983. Preliminary Geology and Structure Map of Part of the Kalispell Two Degree Quadrangle, Montana: U.S. Geological Survey, Open-File Report 83-502.

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 stratabound copper-silver deposit, Lincoln County, Montana. Ph.d. dissertation, Stanford University. November. pp. 340.

Hayes, T.S. 1995. Letter to R. Miller, DEQ, Response to questions concerning similarities and potential differences between Rock Creek and Troy Revett-style stratabound Copper deposits. On file with the KNF and DEQ.

Hayes, T.S. and M.T. Einaudi. 1986. Genesis of the Spar Lake Strata-Bound Copper-Silver Deposit, Montana: part I. Controls Inherited from Sedimentation and Preore Diagenesis. Economic Geology, 81:1899-1931.

Hayes, T.S. and M.T. Einaudi. 1990. A preliminary study of thermometry and metal sources of the Spar Lake strata-bound copper-silver deposit, Belt Supergroup, Montana. USGS Open File Report 90-0484.

Hayward, G.D. and J. Verner (tech. eds.). 1994. Flammulated, western, and great gray owls in the United States: A technical conservation assessment. General Technical Report RM-253. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 214 pp. 3 maps.

HDR Engineering, Inc. 2007. Memorandum on electrical and magnetic fields and audible noise. Submitted to the KNF and the DEQ. pp. 4.

HDR Engineering, Inc. 2008. Estimate of Probable Construction Cost. Submitted to the KNF and DEQ. April.

Heinemeyer, K.S. and J.L. Jones. 1994. Fisher biology and management in the western United States: a literature review and adaptive management strategy. USDA Forest Service, Region 1. Missoula, MT. 109 pp.

Heinz, G. (tech. ed.) 1996 (unpublished). Fisher (*Martes pinnanti*). KNF. Libby, MT. 4 pp.

Hendricks, P., K.A. Jurist, D.L. Genter, and J.D. Reichel. 1995. Bat survey of the Kootenai National Forest, Montana: 1994. Report to USDA Forest Service, KNF, Libby, MT. Montana Natural Heritage Program. Helena, MT. 48 pp.

Hendricks, P., K.A. Jurist, D.L. Genter, and J.D. Reichel. 1996. Bats of the Kootenai National Forest, Montana. Report to USDA Forest Service, KNF, Libby, MT. Montana Natural Heritage Program. Helena, MT. 99 pp.

Highway Capacity Manual. 2000. Transportation Research Board, National Research Council, Washington, DC, National Academy of Sciences. Chapters 12, 17, 20, and 21.

Hillis, J.M., M.J. Thompson, J.E. Canfield, L.J. Lyon, C.L. Marcum, P.M. Dolan, and D.W. McCleery. 1991. Defining elk security: the Hillis paradigm. pp. 38-43. *In* A.G. Christensen, L.J. Lyon, and T.N. Lonner, comps., Proc. Elk Vulnerability Symp., Montana State University, Bozeman, MT. 330 pp.

Hintz, L. and L. Lockard. 2006. Upstream Fish Passage Studies Annual Progress Report - 2005, Fish Passage / Native Salmonid Program, Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, NT and Avista Corporation, Noxon, MT.

Hintz, L. and L. Lockard. 2007. Upstream Fish Passage Studies Annual Progress Report - 2006, Fish Passage / Native Salmonid Program, Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Historical Research Associates, Inc. 1989a. Cultural Resource Inventory, Noranda's Montana Project, Lincoln and Sanders Counties, Montana. Prepared for Noranda Minerals Corporation. Submitted to the KNF and the DEQ. pp. 58 plus appendices.

Historical Research Associates, Inc. 1989b. Cultural Resource Inventory of the Bear Creek Road and Two Proposed Percolation Pond Sites, Lincoln County, Montana. Prepared for Noranda Minerals Corporation. Submitted to the KNF and the DEQ. pp. 7.

Historical Research Associates, Inc. 1989c. Cultural Resource Data Review of Noranda's Proposed Transmission Line, Lincoln County, Montana. Prepared for Noranda Minerals Corporation. Submitted to the KNF and the DEQ. pp. 15.

Historical Research Associates, Inc. 1990. Cultural Resource Reconnaissance of Noranda's Montanore Powerline Corridors and Related Features, Lincoln County, Montana. Prepared for Noranda Minerals Corporation. Submitted to the KNF and the DEQ. pp. 13.

Historical Research Associates, Inc. 2006a. Draft Report, Archaeological survey of portions of the proposed Montanore Project, Kootenai National Forest, Lincoln County, MT. Submitted to the KNF and the DEQ. pp. 39 plus appendices.

Historical Research Associates, Inc. 2006b. Draft Report, Archaeological survey of the proposed transmission line associated with the Montanore Project, Kootenai National Forest, Lincoln County, MT. Submitted to the KNF and the DEQ. pp. 30 plus appendices.

Hoffman, G., B. Marotz, J. DeShazer, T. Ostrowski, and J. Dunnigan. 2002. Mitigation for the Construction and Operation of Libby Dam. Project Number 1995-00400. Bonneville Power Administration Report DOE/BP-00006294-1. pp. 163.

Holdeman Landscape Architecture, LLC. 2006. Visual analysis methods. Submitted to the KNF and the DEQ. pp. 3.

Horn C., and T. Tholl. 2008 Native salmonid abundance and tributary habitat restoration monitoring, including summarized data, 1999-2007, Appendix B. Report to Avista Corporation, Spokane, WA. Montana Fish, Wildlife and Parks, Thompson Falls, and Avista Corp., Noxon, MT.

Hortness, J.E. 2006. Estimating low-flow frequency statistics for unregulated streams in Idaho. U.S. Geological Survey Scientific Investigations Report 2006-5035. pp. 15 plus appendices.

Huntingdon Chen-Northern, Inc. 1994. 1993 Water resources monitoring program, summary report, March 1993 through October 1993. Submitted to the Montana Department of State Lands.

Huntingdon Engineering & Environmental, Inc. 1995. 1994 Water resources monitoring program, summary report, January 1994 through December 1994. Submitted to the Montana Department of State Lands.

Hutto, R.L. 1995. The composition of bird communities following stand-replacement fires in northern Rocky Mountain conifer forests. Conservation Biology 9:1041-1058.

HydroQual, Inc. 2008. Calculation of BLM Fixed Monitoring Benchmarks for Copper at Selected Monitoring Sites in Colorado. Final Report. GLEC.030.004.01.001. Report prepared for the U.S. Environmental Protection Agency.

Idaho Department of Fish and Game. 2004. White-tailed deer management plan 2005-2014. Boise, ID. 62 pp.

Interagency Grizzly Bear Committee (IGBC). 1998. Interagency Grizzly Bear Committee – Taskforce report: Selkirk/Cabinet-Yaak Grizzly Bear Recovery Areas, interim access management rule set. 8 pp.

Interagency Grizzly Bear Committee (IGBC). 1990. CEM – A model for assessing effects on grizzly bears. USDA Forest Service, U.S. Fish and Wildlife Service, BLM, Idaho Department of Fish and Game, Montana Fish, Wildlife, and Parks, Wyoming Fish and Game, National Park Service, Washington Department of Wildlife. Missoula, MT. 24 pp.

Interagency Grizzly Bear Committee. 2004. Identifying and managing wildlife linkage approach areas on public lands. IGBC Public Lands Wildlife Linkage Taskforce. June 17. 35 pp.

IRIS. 2005. Available at: <www.epa.gov/iris/>.

Jackman, S.M. 1974. Woodpeckers of the Pacific Northwest: their characteristics and their role in the forests. M.S. thesis, Oregon State University, Corvallis, OR.

Jambor, J.L., D.W. Blowes, and C.J. Ptacek. 2000. Mineralogy of mine wastes and strategies for remediation. European Mineralogical Union Notes in Mineralogy, Volume 2 (2000), Chapter 7. pp. 260.

Japser Geographics. 2005. Technical report on asbestos sampling of the Montanore Project. Submitted to the KNF and the DEQ. pp. 4 plus appendices.

Jepson, Wayne. 2008. Hydrologist, DEQ. Email communication with Barbara Galloway, Hydrologist, ERO Resources Corporation. DEQ Project Record, Montanore Project. November 17.

Jeresek, J. 2006a. Recreation Specialist, KNF. Personal communication with Julia Grant, Natural Resource Specialist, ERO Resources Corporation. KNF, Project Record, Montanore Project. January 23.

Jeresek, J. 2006b. Recreation Specialist, KNF. Personal communication with Julia Grant, Natural Resource Specialist, ERO Resources Corporation. KNF Project Record, Montanore Project. September 28.

Johns, W.M. 1970. Geology and mineral deposits of Lincoln and Flathead counties, Montana. Montana Bureau of Mines and Geology Bulletin 79.

Johnson, W.J. 1999 (unpublished). Sensitive Species Status Summary: KNF. USDA Forest Service. Libby, MT. 36 pp.

Johnson, W.J. 2003 (unpublished). Incidental Take Analysis for Grizzly Bears that occur outside Recovery Zones on the Kootenai and Idaho Panhandle National Forests and a portion of the Lolo National Forest. USDA Forest Service, Kootenai NF. Libby, MT. 32 pp.

Johnson, W.J. (editor). 2004a (unpublished). A Conservation Plan Based on the 1987 KNF Land Management Plan as Amended. KNF Wildlife-Fish-Botany (WFB) Steering Group KNF. Libby, MT. 17 pp. plus appendices.

Johnson, W.J. (editor). 2004b (unpublished). Wolverine and Fisher Hierarchical Approach to Conservation on the KNF. USDA Forest Service, KNF Wildlife-Fish-Botany (WFB) Steering Group Kootenai NF. Libby, MT. 8 pp.

Johnson, W.J. 2007a. In defense of Wakkinen and Kasworm (1997) paper as "best science" in the Selkirk and Cabinet-Yaak Grizzly Bear Ecosystems. Unpublished Report, USDA Forest Service, KNF. Libby, MT. 8 pp

Johnson, Wayne J. 2007b. Clarification of "Grizzly bear analysis requirements in light of Judge Molloy's December 13, 2006 decision to set aside the 2002 Final EIS and 2004 ROD for the Access Amendment". Unpublished report, September 25. USDA Forest Service, KNF, Libby, MT. 2pp.

Johnson, W.J. 2007c. Rationale for grizzly bear effects analysis process following Judge Molloy's decision (12/13/2006) to set aside the "Access Amendment" EIS and ROD. Unpublished Report, September 28. USDA Forest Service, KNF. Libby, MT. 4 pp.

Johnson, W. (editor), B. Lyndaker, D. Wrobleski, W. Kasworm and W. Wakkinen. 2008. **"**Bear Year" Definition for the Cabinet-Yaak Ecosystem. USDA Forest Service unpublished report. Kootenai, Idaho Panhandle, and Lolo NF. Libby, MT. 2 pp.

Johnson, W. and F. Lamb. 1998 (unpublished). Forest Plan Monitoring: Snags. USDA Forest Service, KNF. Libby, MT. 4 pp.

Jomini, P.P. 2006a. Safety Management Engineer, Montana Department of Transportation. Letter to Gary Strike, Senior Engineer, Ogden Engineering & Consulting. March 24.

Jomini, P.P. 2006b. Safety Management Engineer, Montana Department of Transportation. Letter to Gary Strike, Senior Engineer, Ogden Engineering & Consulting.

Jones, J.L. and E.O. Garton. 1994. Selection of successional stages by fishers in northcentral Idaho. *In* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski. (tech. 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. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 184 pp.

Joslin, G. 1980. Mountain Goat Habitat Management Plan for the Cabinet Mountains, Montana. Montana Fish, Wildlife, and Parks, Helena, MT. 122 pp.

Joslin, G. and H. Youmans (coordinators). 1999. Effects of recreation on Rocky Mountain wildlife: A review for Montana. Committee on effects of recreation on wildlife, Montana Chapter of the Wildlife Society. 307 pp.

Justice, Ken. 2008. Pilot, Kalispell Regional Medical Center, ALERT Air Ambulance. Personal communication with Bill Mangle, Natural Resource Planner, ERO Resources Corporation. January 18.

Kasworm, W. 2008. Grizzly Bear Update for the Selkirk/Cabinet-Yaak Interagency Grizzly Bear Committee. Internal Forest Service memorandum, November 6. On file with the KNF.

Kasworm, W. and S. Knick. 1989. Shooting mortality in small populations of grizzly bears. Wildlife Society Bulletin 17:11-15.

Kasworm, W. and T. Manley. 1988. Grizzly bear and black bear ecology in the Cabinet Mountains of northwest Montana. Montana Fish, Wildlife, and Parks. Helena, MT. 122 pp.

Kasworm, W. and T. Their. 1990. Cabinet-Yaak Ecosystem Grizzly Bear and Black Bear Research Progress Report. USDI Fish and Wildlife Service. Missoula, MT. 53 pp.

Kasworm, W.F., H. Carriles, T.G. Radandt, and C. Servheen. 2005. Cabinet-Yaak Grizzly Bear Recovery Area 2004 Research and Monitoring Progress Report. USDI Fish and Wildlife Service, University of Montana. Missoula, MT. 69 pp.

Kasworm, W.F., H. Carriles, T.G. Radandt, and C. Servheen. 2007. Cabinet-Yaak Grizzly Bear Recovery Area 2006 Research and Monitoring Progress Report. USDI Fish and Wildlife Service. Missoula, MT. 69 pp.

Katzman, L., and L. Hintz. 2003. Bull River Westslope Cutthroat Trout and Bull Trout Life History Study, Final Report-2000. Fish Passage/Native Salmonid Restoration Plan, Appendix C, and Montana Tributary Habitat Acquisition and Recreational Fisher Enhancement Program, Appendix B. Report to Avista Corporation, Spokane, WA. Montana Fish, Wildlife and Parks, Thompson Falls, and Avista Corp., Noxon, MT.

Kimbell, A.R. 2004. Northern Region revised sensitive species list. 2670 letter, USDA Forest Service Region 1. Missoula, MT. 10 pp.

Kimbell, A.R. 2005. Addition of the goshawk and black-backed woodpecker to the R1 sensitive species list. 2670 letter March 31. USDA Forest Service, Region 1. Missoula, MT. 1p.

Klemm, D.J., P.P.A. Lewis, F. Fulk, and J.M. Lazorchak. 1990. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters. EPA/600/4-90/030. Office of Water, Washington, DC.

Klepfer Mining Service LLC. 2008a. Montanore Project - Permit 150 – Revisions. Letter to Warren McCullough, DEQ. pp.2.

Klepfer Mining Service LLC. 2008b. Petition to amend the Montanore Project Hard Rock Mining Impact Plan. Letter to Joe LaForest, Montana Hard Rock Mining Impact Board. pp. 2.

Kline Environmental Research, LLC, ADC Services, Inc., and Watershed Consulting, LLC. 2005. Montanore Project: Fish passage status of culverts. Submitted to the KNF and the DEQ. pp. 8 plus appendices.

Kline Environmental Research, LLC, and Watershed Consulting, LLC. 2005a. Montanore Project: Stream fish surveys, Year 2005. Submitted to the KNF and the DEQ. pp. 7.

Kline Environmental Research, LLC, and Watershed Consulting, LLC. 2005b. Montanore Project: Spawning gravel composition, Year 2005. Submitted to the KNF and the DEQ. pp. 10 plus appendices.

Kline Environmental Research, LLC. 2004. Summary and update of stream biology and habitat information for the Montanore Project. Submitted to the KNF and the DEQ. pp. 35 plus appendices.

Kline Environmental Research, LLC. 2005a. Montanore Project: Fish habitat potential in the Little Cherry Creek tailings impoundment diversion. Submitted to the KNF and the DEQ. pp. 20 plus appendices.

Kline Environmental Research, LLC. 2005b. Montanore Project: Permanent, natural barriers to upstream movement of fish. Submitted to the KNF and the DEQ. pp. 20.

Klohn Crippen Berger Ltd. 2007. Montanore tailings facility, updated design aspects. Prepared for Mines Management, Inc. Submitted to the KNF and the DEQ. pp. 49.

Klohn Crippen Berger Ltd. 2008. Montanore tailings storage facility: requirements for consideration of artesian pressures. Prepared for Mines Management, Inc. Submitted to the KNF and the DEQ. pp. 2.

Klohn Crippen Consultants Ltd. 2005. Draft Tailings Technical Design Report. Submitted to the KNF and the DEQ. pp. 149 plus appendices.

KNF Lynx Taskforce. 1997. Lynx Conservation Strategy KNF. USDA Forest Service Libby, MT. 6 pp. plus appendices.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 51(2):415-420.

Knight-Piesold and Co. 2007. Genesis Inc. Troy Mine, Report on Phase 2 Program on Stability Analyses, Capacity Review and Recommendations for Ongoing Raises. Submitted to the KNF and the DEQ. p. 15.

Kocis, S.M., D.B.K. English, S.J. Zarnoch, R. Arnold, and L. Warren. 2003. National Visitor Use Monitoring Results-KNF. USDA Forest Service, Region 1. pp. 23.

Kolbe, J.A., J.R. Squires, D.H. Pletscher, and L.F. Ruggiero. 2007. The Effect of Snowmobile Trails on Coyote Movements Within Lynx Home Ranges. Journal of Wildlife Management 71(5):1409 – 1418.

Kootenai National Forest and Montana Department of Environmental Quality. 2006. Montanore Project: Scoping content analysis report. pp. 25 plus appendix.

Kootenai National Forest. 1986. Cabinet Mountains Mineral Activity Coordination Report. pp. 68 plus appendices.

Kootenai National Forest. 1993. Conservation Assessment *Thelypteris phegopteris*. Unpublished report of KNF. Libby, MT.

Kootenai National Forest. 2002. Kootenai National Forest Heritage Guidelines: Site Survey Strategy. On file with the KNF.

Kootenai National Forest. 2005. Roads Analysis Report. On file with the KNF.

Kootenai National Forest. 2007a. Kootenai National Forest Invasive Plant Management Final EIS, Appendix A. pp. 14.

Kootenai National Forest. 2007b. KNF Equivalent Clearcut Acres (ECA) Calculator. pp. 8.

Kootenai National Forest. 2007c. Biological Assessment for bull trout (*Salvelinus confluentus*) and white sturgeon (*Acipenser transmontanus*), Mytee Fine Placer Suction Dredging and Trenching, Libby Creek. pp 22. On file with the KNF.

Kootenai National Forest. 2008. KNF Noxious Weed Handbook, Spring 2008, Edition 5.0. On file with the KNF.

Kootenai Tribe of Idaho and Montana Fish, Wildlife and Parks (FWP). 2004. Kootenai Subbasin Plan. Part 1: Kootenai River Subbasin Assessment. Prepared for the Northwest Power and Conservation Council. Portland, OR.

Kunz, T.H., and R.A. Martin. 1982. *Plecotis townsendii*. Mammalian Species. No. 175. pp. 1-6.

Lange, I.M. and R.A. Sherry. 1983. Genesis of the sandstone (Revett) type of copper-silver occurrences in the Belt Supergroup of NW Montana and NE Idaho. Geology. pp. 643-646.

Laudon, K. 2008. Wolf Management Specialist, Montana Fish, Wildlife, and Parks. Personal communication with K. Baud, Wildlife Biologist, ERO Resources Corporation. September 18 and October 5.

Leary, R. 2003. Memorandum to Mike Hensler, Montana Fish, Wildlife, and Parks regarding results of genetic analysis of trout. May 1.

Leary, R. 2006. Memorandum to Mike Hensler, Montana Fish, Wildlife, and Parks regarding results of genetic analyses of trout from Little Cherry Creek. January 16.

Leirfallom, J. 1970. Wolf management in Minnesota. *in*: Jorgensen, S.E., L.E. Faulkner, and L.D. Mech (eds.). Proceeding symposium on wolf management in selected areas of North America. USDI Fish and Wildlife Service. 50 pp. *In* Frederick, G. P. 1991. Effects of Forest Roads on Grizzly Bears, Elk, and Gray Wolves: A Literature Review. USDA Forest Service, KNF, 506 U.S. 2 West. Libby, MT. 53 pp.

Lenat, D.R. and D.L. Penrose. 1996. History of EPT taxa richness metric. Bulletin of the North American Benthological Society 13:305-307.

Liermann, B.W. and T. D. Tholl. 2003. Bull River and Elk Creek temperature and sediment investigations final report-2002, Montana Tributary Habitat Acquisition and Recreational Fisher Enhancement Program, Appendix B. Report to Avista Corporation, Spokane, WA. Montana Fish, Wildlife and Parks, Thompson Falls, and Avista Corp., Noxon, MT.

Lincoln County 2004. Lincoln County, Montana. Integrated Noxious Weed Management Plan. Available at: <http://www.lincolncountymt.us/County%20Weed%20plan%2004.pdf>.

Linkhart, B.D. 2001. Life history characteristics and habitat quality of flammulated owls (*Otus flammeolus*) in Colorado. Ph. D. Dissertation. University of Colorado, Boulder, CO. 221 pp.

Linkhart, B.D. and R.T. Reynolds. 1997. Territories of flammulated owls (*Otus flammeolus*): is occupancy a measure of habitat quality? Pages 250-254 in J.R. Duncan, D.H. Johnson, and T.H. Nicholls, editors. Biology and Conservation of owls in the Northern Hemisphere. USDA Forest Service General Technical Report NC-190.

Linkhart, B.D., R.T. Reynolds, and R.A. Ryder. 1998. Home range and habitat of breeding flammulated owls in Colorado. Wilson Bull. 110(3):342-351.

Lockard, L., R. Weltz, J. Stover, E. Stender, J. Storaasli. 2003. Downstream Juvenile Bull Trout Transport Program Annual Progress Report - 2002, Fish Passage/Native Salmonid Program. Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Lockard, L., L. Hintz, S. Wilkinson, and S. Skaggs. 2004a. Experimental Adult Fish Passage Studies Annual Progress Report - 2003, Fish Passage / Native Salmonid Program, Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Lockard, L., R. Weltz, J. Stover, E. Stender, J. Storaasli. 2004a. Downstream Juvenile Bull Trout Transport Program Annual Progress Report - 2003, Fish Passage / Native Salmonid Program. Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Lockard, L. and L. Hintz. 2005. Upstream Fish Passage Studies Annual Progress Report - 2004, Fish Passage / Native Salmonid Program, Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Lockard, L., R. Weltz, and E. Stender-Wormwood. 2005. Tributary Trapping and Downstream Juvenile Bull Trout Transport Program Annual Progress Report - 2004, Fish Passage / Native Salmonid Restoration Program. Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Lockard, L., R.Weltz, J. Stover, and S. Skaggs. 2008. Tributary Trapping and Downstream Juvenile Bull Trout Transport Program Annual Progress Report - 2007, Fish Passage/ Native Salmonid Restoration Program. Appendix C. Report to Avista Corporation, Spokane, Washington. U.S. Fish and Wildlife Service, Creston, MT and Avista Corporation, Noxon, MT.

Logan. R. 2001. Water Quality BMPs Best Management Practices For Montana Forests. MSU Extension Service EB 158, pp. 58.

Lydy, M.J., C.G. Crawford, and J.W. Frey. 2000. A comparison of selected diversity, similarity, and biotic indices for detecting changes in benthic-invertebrate community structure and stream quality. Archives of Environmental Contamination and Toxicology 39:469-479.

Lyon, L.J. 1966. Problems of habitat management for deer and elk in the northern forests. Research Paper INT-24. USDA Forest Service, Intermountain Forest and Range Research Station. Ogden, UT. 15 pp.

Lyon, L.J. 1979. Habitat effectiveness for elk as influenced by roads and cover. Journal For. 77:658-660.

Lyon, L. J. 1984. Field tests of elk/timber coordination guidelines. Research paper INT – 325. USDA Forest Service, Intermountain Forest and Range Research Station. Ogden, UT. 10 pp.

Lyon, L.J., T.N. Lonner, J.P. Weigand, C.L. Marcum, W.D. Edge, J.D. Jones., D.W. McCleery, and L.L. Hicks. 1985. Coordinating elk and timber management, final report of the Montana cooperative elk-logging study 1970-1985. Montana Fish, Wildlife and Parks. Helena, MT. 53 pp.

Mackie, R.J., D.F. Pac, K.L. Hamlin, and G.L. Dusek. 1998. Ecology and Management of Mule Deer and White-tailed Deer in Montana. Montana Fish, Wildlife and Parks. Helena, MT. 180 pp.

Mahar, J.W. and G.G. Marino. 1981. Building Response and Mitigation Measures for Building Damages in Illinois. Proceedings, Workshop on Surface Subsidence due to Underground Mining. Morgantown, WV. pp. 238–252.

Mallonnee, J. 2006. Research Biologist. Wolf and Wildlife Studies. Personal communication with Al Bratkovich, Wildlife Biologist, KNF. June, KNF Project Record, Montanore Project.

Mannan, R.W. 1977. Use of snags by birds, Douglas-fir region, western Oregon. M.S. thesis, Oregon State University, Corvallis, OR.

Mannan, R.W., E.C. Meslow, and H.M. Wight. 1980. Use of snags by birds in Douglas-fir forests, western Oregon. Journal of Wildlife Management 44:787-97.

Martell, M. 1992. Bald Eagle Winter management guidelines. USDI Fish and Wildlife Service, Region 3. Minneapolis, MN.

Maxell, B.A. 2000. Management of Montana's Amphibians: A Review of Factors that may present a Risk to Population Viability and Accounts on the Identification, Distribution, Taxonomy, Habitat Use, Natural History and the Status and Conservation of Individual Species. A Report (#43-0343-0-0224) to Northern Regional Office, USDA Forest Service. Missoula, MT 59807. 161 pp.

Maxell, B.A., J.K. Werner, P. Hendricks, and D. Flath. 2003. Herpetology in Montana: A history, status summary, checklists, dichotomous keys, accounts for native, potentially native and exotic species, and indexed bibliography. Northwest Fauna 5. Society for Northwestern Vertebrate Biology. Olympia, WA. 138 pp.

Maxim Technologies, Inc. 1996. 1995 Water resources monitoring program, summary report, January through December 1995. Submitted to the Montana Department of Environmental Quality.

Maxim Technologies, Inc. 1997. 1996 Water resources monitoring program, summary report. Submitted to the Montana Department of Environmental Quality.

Maxim Technologies, Inc. 1998. 1997 Water resources monitoring program, summary report. Submitted to the Montana Department of Environmental Quality.

Maxim Technologies, Inc. 2003. Rock Creek Project: 2003 Geochemistry Review. Report prepared for KNF.

Maxim Technologies, Inc. 2004. Draft Engineering Evaluation Cost Analysis: Snowshoe Mine, Snowshoe Creek, and Big Cherry Millsite. May.

Maxim Technologies, Inc. 2005. Visual resources baseline study, Montanore Project. Submitted to the KNF and the DEQ. p. 9.

McAllister, K. 2007. Project Analysis in Region 1: Northern Goshawk guidance, black-backed woodpecker guidance and removal of the northern goshawk from the sensitive species list. USDA FS 1380-3 letter of July 17, 2007. Northern Region, Missoula, MT. 2pp

McCarigal, K., R.G. Anthony, and F.B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs #115.

McClelland, B.R. 1977. Relationship 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, MT. 495 pp.

McClelland, B.R. 1979. The pileated woodpecker in forests of the northern Rocky Mountains, pp. 283-299 *in* The role of insectivorous birds in forest ecosystems, Dickson, James G., R.N. Conner, R.R. Fleet, J.C. Kroll, and J.A. Jackson, [editors]. Academic Press, New York, NY.

McClelland, B.R., and P.T. McClelland. 1999. Pileated woodpecker nest and roost trees in Montana: links with old-growth and forest health. Wildlife Society Bulletin 27 (3): 846-857.

McClelland, B.R., S.S. Frissell, W.C. Fisher, and C.H. Halvorson. 1979. Habitat management for hole-nesting birds in forests of western larch and Douglas-fir. Journal of Forestry 77 (8): 480-483.

McGrath, M.T., S. DeStefano, R.A. Riggs, L.L. Irwin, and G.J. Roloff. 2003. Spatially explicit influences on northern goshawk nesting habitat in the interior Pacific Northwest. Wildlife Monographs No. 154, 63 pp.

McKay, J. 2007. Senior Geologist. KNF. Personal communication with Michael Galloway, senior hydrogeologist. ERO Resources Corporation. October.

McKelvey, K.S., Y.K. Ortega, G.M. Koehler, K.B. Aubry, and J.D. Brittell. 2000. Canada lynx habitat and topographic use patterns in north central Washington: a reanalysis. Pages 307-336. *In* Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (tech. eds.). Ecology and conservation of lynx in the United States. University Press of Colorado. Boulder, CO. 480 pp.

McLeod, H. and Plewes, H. 1999. Risk Management Analysis, Canadian Dam Safety Conference, Sudbury, Canada. p. 10

McMaster, K. 1995. Amended Biological Opinion on Kootenai Forest Plan to include an Incidental Take Statement. Letter to R. Schrenk, Forest Supervisor. USDI Fish and Wildlife Service. Helena, MT. July 27. 15 pp.

Mellen, T.K. 1987. Home range and habitat use of pileated woodpeckers, western Oregon. M.S. thesis, Oregon State University, Corvallis, OR.

Mellen, T.K., E.C. Meslow, and R.W. Mannan. 1992. Summertime home range and habitat use of pileated woodpeckers in western Oregon. Journal of Wildlife Management 56 (1): 96-103.

Mine Development Associates. 2003. Draft, Mineralization on the Montanore Project, Sanders County, Montana. Report for Mines Management Corporation. *In* Geomatrix Consultants, Inc. 2006a. Water resources report for CMW Area, Montanore Mine Project. Submitted to the KNF and the DEQ. p. 37 plus appendices.

Mine Safety and Health Administration. 1999. Haul road inspection handbook. Handbook Number PH99-I-4. p. 76.

Mines Management, Inc. 2005a. Revised application/re-authorization, hard rock operating permit and proposed plan of operations, Montanore Project, Lincoln and Sanders Counties, Montana. Submitted to the KNF and the DEQ. p. 425 plus appendices.

Mines Management, Inc. 2005b. Application for a 230-kV transmission line, Montanore Project, Lincoln County, Montana. Submitted to the KNF and the DEQ. p. 108 plus appendices.

Mines Management, Inc. 2006. Ecological Assessment and Best Management Practices for the Montanore Mine Facilities in Regard to INFISH Standards and Guidelines (Draft). Submitted to the KNF and the DEQ. p. 16 plus appendices.

Mitchell, M. C. and A. Bratkovich. 1993. Bird abundance in old growth forest fragments and harvested stands in the Kootenai National Forest (unpublished). KNF. Libby, MT. 24 pp.

Montana Bald Eagle Working Group (MBEWG). 1991. Habitat management guide for bald eagles in northwestern Montana. USDA Forest Service. Missoula, MT. 29 pp.

Montana Bald Eagle Working Group (MBEWG). 1994. Montana bald eagle management plan. Department of the Interior, Bureau of Land Management. Billings, MT. 61 pp.

Montana Bull Trout Restoration Team. 2000. Restoration plan for bull trout in the Clark Fork River Basin and Kootenai River Basin Montana. Prepared for Governor Marc Racicot. Helena, MT.

Montana Bull Trout Scientific Group. 1996. Lower Clark Fork River Drainage Bull Trout Status Report (Cabinet Gorge Dam to Thompson Falls). Prepared for the Montana Bull Trout Restoration Team. Helena, MT.

Montana Bull Trout Scientific Group. 1998. The relationship between land management activities and habitat requirements for bull trout. Prepared for the Montana Bull Trout Restoration Team. Helena, MT.

Montana Fish, Wildlife and Parks (FWP). 2004a. Statewide elk management plan for Montana. Wildlife Division. Helena, MT. 394 pp.

Montana Fish, Wildlife and Parks (FWP). 2004b. Region One Elk Annual Report. Prepared by Bruce Sterling. July 2003 to June 2004.

Montana Fish, Wildlife and Parks (FWP). 2004c. Region One White-tailed Deer Progress Report. Prepared by Tom Litchfield. 67 pp.

Montana Fish, Wildlife and Parks (FWP). 2005. Now You Know: A collection of facts and figures about Montana Fish, Wildlife, and Parks. pp. 57.

Montana Fish, Wildlife and Parks (FWP). 2007a. Region One Elk Annual Report, July 2004–June 2007. Prepared by B. Sterling.

Montana Fish, Wildlife and Parks (FWP). 2007b. Moose Management in Northwest Montana, Region One Annual Report, July 1, 2006 – June 30, 2007. Prepared by J. Brown.

Montana Fish, Wildlife and Parks (FWP). 2007c. Moose Management in Northwest Montana, Region One Annual Report, July 1, 2006 – June 30, 2007. Prepared by J. Brown.

Montana Fish, Wildlife and Parks (FWP). 2008a. Montana Fisheries Information System. Available at: <http://fwp.mt.gov/fishing/mfish/>.

Montana Fish, Wildlife and Parks (FWP). 2008b. Region One White-tailed Deer Report. Prepared by John Vore. 23 pp.

Montana Fish, Wildlife and Parks (FWP). 2008c. Region One White-tailed Deer Report. Prepared by John Vore. 23 pp.

Montana Fish, Wildlife and Parks (FWP). 2008d. Montana Statewide Angling Pressure–2007. p. 173.

Montana Fish, Wildlife and Parks (FWP). 2009. FWP Goals and Objectives. Available at: <http://fwp.mt.gov/doingBusiness/insideFwp/aboutUs.html>.

Montana Fish, Wildlife and Parks (FWP) and Montana Natural Heritage Program (MNHP). 2006. Montana Animal Species of Concern. Available at: <http://fwp.mt.gov/wildthings/concern/default.html>.

Montana Fish, Wildlife and Parks (FWP) and Montana Natural Heritage Program (MNHP). 2007. Animal Field Guide. Available at: <http://fwp.mt.gov/fieldguide/detail_AMALC03010.aspx>.

Montana Department of Transportation. 2006. Traffic Data Collection Section. E-mails to Gary Strike, Senior Engineer, Ogden Engineering & Consulting.

Montana Department of Transportation. 2000. Montana Road Design Manual, Chapter 13, Intersections at Grade.

Montana Natural Heritage Program (MNHP). 1993. *Plecotus townsendii*, Townsend's big-eared bat. Vertebrate Characterization Abstract. 5 pp.

Montana Natural Heritage Program (MNHP). 2005. Plant and animal species of special concern near the Montanore Project. Element occurrence records provided by Montana Natural Heritage Program. Helena, MT.

Montana Natural Heritage Program (MNHP). 2006a. Plant Species of Concern. Available at: <http://mtnhp.org/plants/plist_bkgrd.asp>.

Montana Natural Heritage Program (MNHP). 2006b. Survey of historical northern goshawk nesting territories on the Kootenai National Forest: progress report. Helena, MT. 9 pp.

Montana Natural Heritage Program (MNHP). 2008. Species of concern reports found at: <http://nhp.nris.mt.gov/SpeciesOfConcern/>.

Montana/Northern Idaho Level I Team. 2006. Guide to Effects Analysis of Helicopter Use in Grizzly Bear Habitat. December. 6 pp.

Montana Summit Steering Committee Weed Management Task Force. 2005. The Montana Weed Management Plan. Available at: <http://agr.mt.gov/weedpest/pdf/2005weedPlan.pdf>.

Montanore Minerals Corp. 2006. Notification to resume suspended exploration and drilling activities for the Montanore Project. Submitted to the KNF and the DEQ. p. 20 plus appendices.

Montanore Minerals Corp. 2008. Updated Plan of Operations. Submitted to the KNF. pp. 220 plus appendices.

Moran, S. and J. Storaasli. 2008. Non-native Fish Suppression project in the East Fork Bull River, Montana. Annual Progress Report - 2007. Fish Passage/Native Salmonid Program Appendix C. Prepared for Avista Corporation, Noxon, MT.

Morgan, J.T. 1993. Summer habitat use of white-tailed deer on the Talley Lake Ranger District, Flathead National Forest. Ph.D. Thesis, Montana State University, Bozeman, MT. 103 pp.

Morrison, M.L., B.G. Marcot, R.W. Mannan. 1992. Wildlife-Habitat Relationships: Concepts and Applications. The University of Wisconsin Press. Madison, WI. p. 337.

Morrison-Knudsen Engineers, Inc. 1988. Montana Silver Venture, Alternative sites reconnaissance. Submitted to the KNF and the DSL. p. 9 plus figures and appendices.

Morrison-Knudsen Engineers, Inc. 1989a. Montana Project, Geotechnical report. Submitted to the KNF and the DSL. p. 46 plus figures and appendices.

Morrison-Knudsen Engineers, Inc. 1989b. Montana Project, Geotechnical site evaluation report. Submitted to the KNF and the DSL. p. 33 plus figures and appendices.

Morrison-Knudsen Engineers, Inc. 1990. Montanore Project, Addendum to geotechnical site report. Submitted to the KNF and the DSL. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix N-2. p. 27 plus figures and appendices.

Mundinger, J.G. 1981. Impacts of timber harvest on white-tailed deer in the coniferous forests of northwestern Montana. Montana Fish, Wildlife, and Parks, Kalispell, MT. NW Wildlife Society Meeting, April. 15 pp.

Murie, O.J. 1979. The elk of North America. Teton Bookshop. Jackson, WY. 376 pp.

Nanus, Leora, Donald H. Campbell, George P. Ingersoll, David W. Clow, and M. Alisa Mast. 2003. Atmospheric deposition maps for the Rocky Mountains. Atmospheric Environment 37. pp. 12.

National Atmospheric Deposition Program. 2008. NAPP/NTN Monitoring Location MT05 (Glacier National Park-Fire Weather Station). Statistical Summary of Precipitation Chemistry.

NatureServe. 2007. NatureServe Explorer, An Online Encyclopedia of Life. Available at: <www.natureserve.org/explorer/servlet>. Last updated October 6, 2007.

Neesvig, C. 2006. Hydrologist. KNF. Personal communication with Barbara Galloway, senior hydrologist regarding surface water data. ERO Resources Corporation. July.

New Jersey Department of Environmental Protection. 2007. Technical Guidance for Sizing and Positioning of Spray Irrigation Systems, Overland Flow Systems, Infiltration/Percolation Lagoon Systems, and Surface Impoundments. p. 28.

Noranda Minerals Corp. 1989. Summary of project alternatives. Submitted to the KNF and the DSL. p. 12 plus figure.

O'Connor, T. and M. Hillis. 2001 (unpublished report). Conservation of Post-fire habitat, black-backed woodpeckers and other woodpecker species on the Lolo National Forest. Lolo National Forest. Missoula, MT.

Olendorff, R.R. and N. Lehman. 1986. Raptor collisions with utility lines: an analysis using subjective field observations. Pacific Gas and Electric Co. San Ramon, CA. 73 pp.

Overton, C., K. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) Fish Habitat Standard Inventory Procedures Handbook. General Technical Report INT-6TR-346, USDA Forest Service, Intermountain Forest and Range Research Station, Ogden, UT.

Parametrix. 2005. Bull Trout Species Account. Prepared for Montana Department of Natural Resources and Conservation Forest Management Bureau. Bellevue, WA.

Parker, R. 2008. Senior Land Asset Manager. Plum Creek Timber Company. Personal communication with Bill Mangle, Natural Resource Planner, ERO Resources Corporation. January 24.

Paterson, A. 2006. High Concentration Hydraulic Transport Systems. *In:* Paste and Thickened Tailings – A Guide, Second Edition (Jewell and Fourie, eds.), Australian Centre for Geomechanics, Nedlands, WA, pp. 129–143.

Peng, S.S. 1992. Surface Subsidence Engineering. Society of Mining, Metallurgy, and Exploration. Littleton, CO. p. 161.

Perkins, J.M. and T. Schommer. 1991. Survey protocol and an interim species conservation strategy for *Plecotus townsendii* in the Blue Mountains of Oregon and Washington. Wallowa-Whitman National Forest, P.O. Box 907, Baker City, OR. 23 pp.

Pfister, R.D., W.L. Baker, C.E. Fiedler, and J.W. Thomas. 2000. Contract Review of Old Growth Management on School Trust Lands: Supplemental Bio-Diversity Guidance 8/02/00. Department of Natural Resources and Conservation. Helena, MT. pp. 31.

Pierson, E.D., M.C. Wachenhut, J.S. Altenbach, P. Bradley, P. Call, D.L. Genter, C.E. Harris, B.L. Keller, B. Lengus, L. Lewis, B. Luce, K.W. Navo, J.M. Perkins, S. Smith, and L. Welch. 1999. Species conservation assessment and strategy for Townsend's big-eared bat (*Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallescens*). Idaho Conservation Effort, Idaho Department of Fish and Game. Boise, ID.

Pioneer Technical Services, Inc. 2005. Draft Snowshoe Mine Site Expanded Engineering Evaluation/Cost Analysis (EEE/CA). April.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers. EPA/444/4-89-001.

Plantenberg, P. 2006. Reclamation Specialist, DEQ. Personal communication with David Buscher, Soil Scientist/Ecological Engineer, Buscher Soil & Environmental, Inc. March 15.

Poulter, D. 2007. Poorman Creek impoundment site options. Prepared for ERO Resources Corporation. On file with the KNF and the DEQ. p. 8.

Powell, R.A. and W.J. Zielinski. 1994. Fisher. Chapter 3 *In*: Ruggiero, Leonard F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski. (tech. 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. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 184 pp.

Powell, H.D. 2000. The influence of prey density on post-fire habitat use of the black-backed woodpecker. M.S. thesis, University of Montana, Missoula, MT. 99 pp.

Power Engineers, Inc. 2005a. EMF/noise analysis for the Montanore transmission line. Submitted to the KNF and the DEQ. p. 16.

Power Engineers, Inc. 2005b. Route analysis report for the Montanore transmission line. Submitted to the KNF and the DEQ. p. 28.

Power Engineers, Inc. 2005c. Technical land use report for the Montanore transmission line. Submitted to the KNF and the DEQ. p. 41 plus appendix.

Power Engineers, Inc. 2006a. Montanore transmission line project, 2005 Major Facility Siting Act application, response document to comments from the Montana Department of Environmental Quality on Montanore transmission line project. Submitted to the KNF and the DEQ. p. 194 plus appendices.

Power Engineers, Inc. 2006b. Visual resources report for the Montanore transmission line. Submitted to the KNF and the DEQ. p. 39.

Powers, L.R., A. Danle, P.A. Gaede, C. Rodes, L. Nelson, J.J. Dean, and J.D. May. 1996. Nesting and food habits of the flammulated owl (*Otus flammeolus*) in south-central Idaho. Journal of Raptor Research 30:15-20.

Price, W.A. and J.C. Errington. 1998. Guidelines for metal leaching and acid rock drainage at mine sites in British Columbia.

Price, W.A., K.A. Morin, and N.M. Hutt. 1997. Guidelines for the prediction of acid rock drainage and metal leaching for mines in British Columbia, Part II. Recommended procedures for static and kinetic testing. Proceedings of the Fourth International Conference on Acid Rock Drainage, May 31-June 6, 1997. Vancouver, BC, Canada.

Prodgers, R.A. and T.J. Keck. 1996. Vegetational diversity concepts and strategies for reclamation. *In* Planning, Rehabilitation and Treatment of Disturbed Lands. Seventh Billings Symposium. March 17-23, 1996. Montana State University Reclamation Research Unit Publication Number 9603. Bozeman, MT. pp. 141-157.

Province of British Columbia. 1995. Forest practices code guidebook: Biodiversity. Government Publication Services, Ministry of Forests, Forest Practices Branch. Victoria, BC, Canada.

Reel, S., W. Schassberger, and W. Ruediger. 1989. Caring for our natural community. Region 1. Threatened, Endangered, and Sensitive Species Program. USDA Forest Service, Region 1, Wildlife and Fisheries. 309 pp.

Reichel, J. and D. Flath. 1995. Identification guide to the amphibians and reptiles of Montana. Montana Outdoors 26(3):15-34.

Renken, R.B., W.K. Gram, D.K. Fantz, S.C. Richter, T.J. Miller, K.B. Ricke, B. Russell, and X. Wang. 2004. Effects of Forest Management on Amphibians and Reptiles in Missouri Ozark Forests. Conservation Biology 18(1)1:174-188.

Reynolds, R.T., R.T. Graham, M.H. Reiser, R.L. Bassett, P.L. Kennedy, D.A. Boyce Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management Recommendations for the northern goshawk in the southwestern United States. General Technical Report. RM-217. Fort Collins, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 pp.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and Habitat Requirements for Conservation of Bull Trout. USDA Forest Service General Technical Report INT-302.

Ripple, W.J., G.A. Bradshaw, and T.A. Spies. 1991. Measuring forest landscape patterns in the Cascade Range of Oregon, USA. Biological Conservation 57:73-88.

Robertson, A.G. and S. Shaw. 2003. Risk management for major geotechnical structures on mines. *In:* Proceedings of Computer Applications in the Mineral Industries (CAMI), Calgary, Alberta, Canada. pp. 18.

Rosgen, D. 1985. A stream classification system. *In* Riparian Ecosystems and Their Management: Reconciling Conflicting Issues. General Technical Report Number RM-120. First North American Riparian Conference. USDA Forest Service. Washington, DC.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, CO.

Ross, A. 1967. Ecological aspects of the food habits of insectivorous bats. Proc. Western Foundation of Vertebrate Zoology. 1:205-264.

Roy, K. D. 1991. Ecology of introduced fishers in the Cabinet Mountains of northwest Montana. Missoula, MT: University of Montana. M.S. thesis, 94 pp. *In* Ruggiero, Leonard F., K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski. (tech. 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. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 184 pp.

Ruediger, B.J. Claar, S. Gniadek, B. Holt, L. Lewis, S. Mighton, B. Naney, G. Patton, T. Rinaldi, J. Trick, A. Vandehey, F. Wahl, N. Warren, D. Enger, and A. Williamson. 2000. Canada lynx conservation assessment and strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Publication #R1-00-53. Missoula, MT. pp. 142.

Ruediger, B.J. 1994 (unpublished). Wolverine, Lynx, and Fisher habitat and distribution maps, draft hierarchical approach and draft conservation strategies. USDA Forest Service 2670 letter 9/14/1994. Region 1, Missoula, MT. 5 pp. plus attachments

Ruggiero, L.F., G.D. Hayward, and J.R. Squires. 1994. Viability Analysis in Biological Evaluations: Concepts of Population Viability Analysis, Biological Population, and Ecological Scale. Conservation Biology 8(2):64-372

Ruggiero, L.F., K.B. Aubry, S.W. Buskirk [and others]. 2000. Ecology and Conservation of Lynx in the United States. University Press of Colorado. Boulder, CO. 480 pp.

Russell, W.H. and C. Jones. 2001. The effects of timber harvesting on the structure and composition of adjacent old-growth coast redwood forest, California, USA. Landscape Ecology 16:731-741.

Russell, W.H., J.R. McBride, K. Carnell. 2000. Edge effects and the effective size of old-growth coast redwood preserves. USDA Forest Service Proceedings RMRS-P-15 3:128-136.

Sage Environmental Consulting. 2007. Montanore Mine AERMOD Analyses, Multiple Alternatives. Memo from S. Connell to E. Klepfer, MMC.

Schafer and Associates. 1992. Technical Summary Report: Geochemical Kinetic Testing of Montanore Mine Waste Samples. Report prepared for Noranda Minerals Montanore Project. On file with the KNF and the DEQ.

Schafer and Associates. 1997. Final Report on Rock Creek Humidity Cell Testing. Memo report to Doug Parker, ASARCO. On file with the KNF and the DEQ.

Schippers, A., P. Jozsa, W. Sand, Z.M. Kovacs, and M. Jelea. 2000. Microbiological pyrite oxidation in a mine tailings heap and its relevance to the death of vegetation. Geomicrobiology Journal 17:151-162.

Schirato, M. 1989. Disturbance to wildlife by vehicular activity: an annotated bibliography. Washington Department of Wildlife. Olympia, WA. pp. 13.

Semlitsch, R.D. 2000. Principles for management of aquatic-breeding amphibians. Journal of Wildlife Management 64 (3):615-631.

Servheen, C., J.S. Waller, and P. Sandstrom. 2003. Identification and management of linkage zones for grizzly bears between the large blocks of public land in the northern Rocky Mountains. USDI Fish and Wildlife Service, University of Montana, Missoula, MT. 89 pp.

Shepard, B.B. 2004. Factors that may be influencing non-native brook trout invasion and their displacement of native westslope cutthroat trout in three adjacent southwestern mountain streams. North American Journal of Fisheries Management 24:1088-1100.

Shepard, B.B., K.L. Pratt, and P.J. Graham. 1984. Life Histories of Westslope Cutthroat and Bull Trout in the Upper Flathead River Basin, Montana. Sponsored by: Environmental Protection Agency through the Steering Committee for the Flathead River Basin Environmental Impact Study. Denver, CO.

Sime, C. 2002. Montana Wolf Conservation and Management Planning Document. (Draft), Prepared in response to the wolf management advisory council recommendations. Montana Fish, Wildlife and Parks, Helena, MT. Available at: <www.fwp.state.mt.us/wildthings/wolf>.

Singh, M.M. 1992. Mine Subsidence. SME Mining Engineering Handbook, Chapter 10.6, Society for Mining, Metallurgy, and Exploration. Littleton, CO.

Snow, D.T. 1968. Rock fracture spacing, openings, and porosities. American Society Civil Engineers Proceedings, Journal Soil Mechanics and Foundations. Div. 94:1. pp. 1273-1289.

Spudich, P., W.B. Joyner, A.G. Lindh, D.M. Boore, B.M. Margaris, and J.B. Fletcher. 1999. SEA99: A Revised Ground Motion Prediction Relation for Use in Extensional Tectonic Regimes, Bull. Seism. Soc. Am. 89(5):1156-1170.

Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. Journal of Wildlife Management 47(2):349-359.

Stantus, P. 2006a. Assistant Forest Engineer, KNF. Email to Gary Strike, Senior Engineer, Ogden Engineering & Consulting. February 21.

Stantus, P. 2006b. Assistant Forest Engineer, KNF. Personal communication with Gary Strike, Senior Engineer, Ogden Engineering & Consulting. March 1.

Storaasli, J. and S. Moran. 2008. Lower Clark Fork River, Montana, Avista Project Area. 2007 Annual Bull and brown Trout Redd Survey Report. Appendix C, Fish Passage/Native Salmonid Restoration Plan. Report to Avista Corporation, Spokane, WA. U.S. Fish and Wildlife Service, Creston, and Avista Corporation, Noxon, MT.

Story, M. 2006. Hydrologist. Gallatin National Forest. Personal communication with Barbara Galloway, senior hydrologist regarding Libby Lakes water quality. ERO Resources Corporation.

Story, M.T. 1997. ASARCO Rock Creek Mine Project Libby Lakes MAGIC/WAND Modeling, USDA Forest Service, Gallatin NF.

Stubblefield, W.A. and J.R. Hockett. 2000. Derivation of a Colorado State Manganese Table Value Standard for the Protection of Aquatic Life. ENSR Corporation. Fort Collins, CO. July.

Summerfield, R.L. 1991. Coordinating Big game and Grizzly bear standards. Internal 2600 memo, December 2, 1991. USDA Forest Service. Libby, MT. 4 pp.

Teply, M. and L. Bahls. 2005. Diatom Biocriteria for Montana Streams, 2005. Montana Department of Environmental Quality, Water Quality Monitoring Section, Helena, MT. September. pp. 22 plus appendices,

Tetra Tech, Inc. and R Squared, Inc. 2006. Final geotechnical assessment report, sinkhole development at the Troy Mine and implications for the proposed Rock Creek Mine, Lincoln and Sanders counties, MT. Prepared for the KNF. pp. 42 plus figures and appendices.

Thiel, R.P. 1978. The status of the timber wolf in Wisconsin, 1975. Wisconsin Academy of Sciences, Arts and Letters. 66:186-194.

Thiel, R.P., S. Merrill, and L.D. Mech. 1998. Tolerance by denning wolves, *Canis lupus*, to human disturbance *In:* Joslin, G. and H. Youmans, coordinators. Effects of recreation on Rocky Mountain wildlife: A Review for Montana. Committee on Effects of Recreation on Wildlife. Montana Chapter of the Wildlife Society. 307 pp.

Thomas, A. (coordinator). 1995. Forest Carnivores in Idaho: habitat conservation assessments and conservation strategies. Idaho Department of Fish and Game, Nez Perce Tribe, and Sawtooth National Forest. Boise, ID. 126 pp.

Thomas, J.W. (tech. ed.). 1979. Wildlife Habitats in Managed Forests, the Blue Mountains of Oregon and Washington. USDA Forest Service, Agricultural Handbook No. 553. Wildland Management Institute. Washington, DC.

Thomas, D.W. and S.D. West. 1991. Forage age associations of bats in the Washington Cascade and Oregon Coast Ranges. In: Wildlife and vegetation of unmanaged Douglas-fir forests. General Technical Report PNW-285. Portland, OR. pp. 295-303.

Thompson, R.J. 1989. Draft Evaluation of Alternative Disposal Sites and Disposal Methods for the ASARCO Rock Creek Project. USDA Forest Service, Kootenai National Forest. Libby, MT. pp. 35 plus appendices.

Thorburn, S. and W.M. Reid. 1977. Incipient Failure and Demolition of Two Story Dwellings due to Large Ground Movements. Large Ground Movements and Structures: Proceedings, Conference at University of Wales, Institute of Science and Technology, Cardiff, Wales, Wiley. pp. 87–99.

Tincher, D. 1998 (unpublished). Estimating Snag Levels within 200 feet of open roads on the Fortine Ranger District. USDA Forest Service, KNF, Libby, MT. 1 p.

Toweill, D.E. and J.W. Thomas. (eds.). 2002. North American elk: ecology and management. Smithsonian Institution Press. Washington, DC. 962 pp.

TRC Environmental Corporation. 1989. Air quality permit application for Noranda's Montanore Project. Submitted to the Montana Department of Health and Environmental Sciences.

TRC Environmental Corporation. 2006a. Application for air quality preconstruction permit (revised). Submitted to the KNF and the DEQ. p. 64 plus appendices.

TRC Environmental Corporation. 2006b. AQRV modeling analysis results. Submitted to the DEQ. p. 8 plus appendices.

U.S. Army Corps of Engineers and Environmental Protection Agency. 2007. U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook. May 30.

U.S. Army Corps of Engineers. 1982a. Engineering Manual EM-111-2-1902.

U.S. Army Corps of Engineers. 1982b. Process Design Manual for Land Treatment of Municipal Wastewater. EM 1110-1-501.

U.S. Army Corps of Engineers. 1993. Department of the Army Permit 199270047. On file with the Corps. pp. 28.

U.S. Army Corps of Engineers. 2002. Public Notice. Issue Date: May 10, 2002. Helena Regulatory Office. Omaha District.

U.S. Army Corps of Engineers. 2005. Guidance for Compensatory Mitigation and Mitigation Banking in the Omaha District. Omaha District. Available at: https://www.nwo.usace.army.mil/html/op-r/guidance-aug05.pdf.

U.S. Army Corps of Engineers. 2008. November 12, 2008 letter from Allan Steinle, Montana Program Manager to Eric Klepfer, Klepfer Mining Service LLC regarding preliminary jurisdictional determination of the Poorman Alternative site.

U.S. Census Bureau. 2004. Population Finder. Available at: <http://www.census.gov>.

U.S. Census Bureau. 2006a. State and County QuickFacts. Available at: <http://quickfacts.census.gov/qfd/states/30/30053.html>.

U.S. Census Bureau. 2006b. Selected Economic Characteristics. Available at: <http://www.census.gov/census2000/states/mt.html>.

U.S. Department of Agriculture (USDA). 1997. Departmental Regulation, Environmental Justice. Available at: <http://www.usda.gov/da/5600-2.pdf>.

U.S. Geological Survey (USGS). 1981. Mineral resources of the Cabinet Mountains Wilderness, Lincoln and Sanders counties, USGS Bulletin 1501.

U.S. Geological Survey (USGS). 1983. Elephant Peak and Howard Lake 7.5-minute quadrangles. Denver, CO.

U.S. Geological Survey (USGS). 2007. USGS Water Data for Montana. Available at: <http://waterdata.usgs.gov/MT/nwis>.

U.S. Geological Survey (USGS). 2008. Mineral commodity summaries 2008. pp. 199.

USDA Forest Service and Montana Department of Environmental Quality. 2001. Final Environmental Impact Statement, Rock Creek Project. p. 951 plus appendices.

USDA Forest Service and Natural Resources Conservation Service. 1995. Soil survey of Kootenai National Forest Area. Montana and Idaho. pp. 122.

USDA 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, Montanore Project. p. 471 plus appendices.

USDA Forest Service. 1974. The Visual Management System. Agricultural Handbook Number 462.

USDA Forest Service. 1987. Kootenai Forest Plan, Volumes 1 and 2. KNF, Northern Region. Missoula. MT. p. 660. The Kootenai Forest plan is Available at: <www.fs.fed.us/r1/kootenai/projects/planning/documents/forest_plan/87_plan>.

USDA Forest Service. 1988a. Cumulative effects analysis process for the Selkirk/Cabinet-Yaak Grizzly Bear Ecosystems. 32 pp.

USDA Forest Service. 1988b. Soil and Water Conservation Handbook, Forest Service Handbook 2509:22. R-1 Missoula, Montana/R-4 Ogden, Utah. p. 140.

USDA Forest Service. 1989. General Aquatic Wildlife System User Guide. Intermountain Region. Ogden, UT.

USDA Forest Service. 1990. ROS Primer and Field Guide. Available at: <http://www1.forest.gov.tw/lib/2005_US_Forum/1_ROS/ros_brochure_r6_rec_021_90.pdf>.

USDA Forest Service. 1991. Kootenai Supplement Number 85 to FSM 2432.22 Timber Management. Libby, MT.

USDA Forest Service. 1993. Montanore Project, Final Environmental Impact Statement, Record of Decision. KNF. Libby, MT. p. 22 plus appendices.

USDA Forest Service. 1995. Inland Native Fish Strategy Environmental Assessment Decision Notice and Finding of No Significant Impact. Intermountain, Northern and Pacific Northwest Regions. 17 pp. plus attachments.

USDA Forest Service. 1998a. Biological Opinion for the Effects to Bull Trout from Continued Implementation of Land and Resource Management Plans as Amended by the Interim Strategy for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana, and Portions of Nevada (INFS), and the Interim Strategy for Managing Anadromous Fish Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH). USDA. Available at: <http://www.fs.fed.us/r6/fish/biological-opinions/980823_bt_bo/980823_BO_bull_trout-conv-wp-2000.doc>.

USDA Forest Service. 1998b. Northern Region Landbird Monitoring Project, Field Methods. Missoula, MT. 61 pp.

USDA Forest Service. 1999a. Roads analysis: informing decisions about managing the National Forest Transportation System. Misc. Rep. FS-643. Washington, DC. 222 p. Available at: <http://www.fs.fed.us/eng/road_mgt/01titlemain.pdf>.

USDA Forest Service. 1999b. Vegetation Response Unit characterizations and target landscape prescriptions. KNF. Libby, MT. p. 174. R. Gautreaux (tech. ed.). Available at: <http://www.fs.fed.us/r1/kootenai/projects/planning/documents/vru_doc/index.shtml>.

USDA Forest Service. 2000a. Wayup Mine/Fourth of July Road Access Record of Decision. KNF. February.

USDA Forest Service. 2000b. Wayup Mine/Fourth of July Road Access Final Environmental Impact Statement. KNF. January.

USDA Forest Service. 2000c. Screening Methodology for Calculating ANC Change to High Elevation Lakes, User's Guide. USDA Forest Service, Region 2.

USDA Forest Service. 2001. FSM 2000 – National Forest Resource Management Zero Code 2080 – Noxious Weed Management. USDA Forest Service, Region 1. Missoula, MT.

USDA Forest Service. 2002. Final Environmental Impact Statement, Forest Plan Amendments for Motorized Access Management Within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones for the Kootenai, Lolo, and Idaho Panhandle National Forests. March.

USDA Forest Service. 2003a. Record of Decision, Rock Creek Project. On file with the KNF. pp. 89 plus attachments.

USDA Forest Service. 2003b. Technical Report: Analysis of the Management Situation for Revision of the Kootenai and Idaho Panhandle Forest Plans. March 2003. 149 pp. This document is Available at: <www.fs.fed.us/kipz/documents/ams>.

USDA Forest Service. 2003c. Forest Plan Monitoring and Evaluation Report Fiscal Year 2002. KNF, Libby, MT. 64 pp. Available at: <www.fs.fed.us/r1/kootenai/projects/planning/documents/forest_plan/monitoring>.

USDA Forest Service. 2003d. Fisher Landscape Assessment. Ecological Analysis at the Watershed Scale (EAWS). KNF, Libby Ranger District. September.

USDA Forest Service. 2003e. Libby Ranger District Lynx Analysis Unit Status Report. March 24.

USDA Forest Service. 2004. Draft Environmental Impact Statement Northern Rockies Lynx Amendment National Forests in Montana, parts of Idaho, Wyoming and Utah Bureau of Land Management Units in Idaho and parts of Utah. USDA Forest Service, USDI Bureau of Land Management. Northern Region, Missoula, MT. 416 pp. Available at: <http://www.fs.fed.us/r1/planning/lynx.html>.

USDA Forest Service. 2005a. Habitat Survey Data Sheets 1997-2005. Libby Ranger District.

USDA Forest Service. 2005b. Bear Lakes Access Environmental Assessment. KNF.

USDA Forest Service. 2005c. Forest Plan Monitoring and Evaluation Report Fiscal Years 2003-2004. KNF, Libby, MT. 60 pp. Available at: <www.fs.fed.us/r1/kootenai/projects/planning/documents/forest_plan/monitoring>.

USDA Forest Service. 2005d. Monitoring selected conditions related to the Wilderness character: A National Framework. Fort Collins, CO. p. 38.

USDA Forest Service. 2006a. Draft Interim Ground-Water Resource Inventory and Monitoring Protocol, Level I Spring Ecosystem Inventory.

USDA Forest Service. 2006b. Draft Biological Assessment for Threatened, Endangered, and Proposed Species on the Montanore Mining Corporation Libby Adit – Evaluation Drilling Program. KNF, Libby Ranger District.

USDA Forest Service. 2006c. Spreadsheet - 1998-2004 Metric values for all KNF samples. Created by Mark Vinson.

USDA Forest Service. 2006d. Forest Plan Monitoring and Evaluation Report Fiscal Year 2005. KNF, Libby, MT. 22 pp. Available at: <www.fs.fed.us/r1/kootenai/projects/planning/documents/forest_plan/monitoring>.

USDA Forest Service. 2007a. Northern Rockies Lynx Management Direction Final Environmental Impact Statement and Record of Decision. National Forests in Montana, and parts of Idaho, Wyoming, and Utah, March. pp. 399 plus appendices. Available at: <http://www.fs.fed.us/r1/planning/lynx.html wildlife>.

USDA Forest Service. 2007b. Revised Plan of Operation Addendum for Arnold Bakie, Libby Creek Ventures. KNF, Libby Ranger District.

USDA Forest Service. 2007c. Employment and Labor Income Effects Proposed Montanore Mine Project, Lincoln County, MT.

USDA Forest Service. 2007d. Forest Plan Monitoring and Evaluation Report Fiscal Year 2006. KNF, Libby, MT. 28 pp. Available at: <www.fs.fed.us/r1/kootenai/projects/planning/documents/forest_plan/monitoring>.

USDA Forest Service. 2007e. Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones 2006 Annual Compliance Monitoring Summary Report. Prepared by Johnson, W. and D. Roberts. On file with the KNF. 9 pp.

USDA Forest Service. 2008a. Agency Seepage Analysis of Seepage from Cherry Creek Tailings Dam. pp 2. On file with the KNF.

USDA Forest Service. 2008b. Phase 3 Lake Water Chemistry Monitoring Absaroka Beartooth, Cabinet Mountains, and Selway Bitterroot Wilderness Areas 1994-2007. M.T. Story and J. Grenon, Gallatin National Forest, USDA Forest Service. p 15.

USDA Forest Service. 2008c. Air Resource Management Surface Water and Bulk Deposition Data Website. Available at: <http://www.fs.fed.us/waterdata/>.

USDA Natural Resources Conservation Service (USDA NRCS). 2008. The PLANTS Database Available at: http://plants.usda.gov>. Accessed: January 23). National Plant Data Center, Baton Rouge, LA 70874-4490.

U.S. Department of Agriculture (USDA). 1997a. Guide to USDA Programs for American Indians and Alaska Natives. Program Aid Number 1617. Available at: <http://www.usda.gov/news/pubs/indians/open.htm>.

U.S. Department of Agriculture (USDA). 1997b. Departmental Regulation on Environmental Justice. Available at: <http://www.nrcs.usda.gov/TECHNICAL/ECS/environment/envjust.html>.

USDI Fish and Wildlife Service (USFWS), National Marine Fisheries Service, Plum Creek Timber Company, and CH2M Hill. 2000. Final Environmental Impact Statement and Native Fish Habitat Conservation Plan – Proposed Permit for Taking of Federally Listed Native Fish Species on Plum Creek Timber Company, Inc. Lands. September.

USDI Fish and Wildlife Service (USFWS). 1978. Recovery plan for the eastern timber wolf. U.S. Gov. Printing Office, Washington, DC. 79 pp. *In*: Frederick, G.P. 1991. Effects of Forest Roads on Grizzly Bears, Elk, and Gray Wolves: A Literature Review. USDA Forest Service, KNF, 506 U.S. 2 West, Libby, MT. 53 pp.

USDI Fish and Wildlife Service (USFWS) 1987. Northern Rocky Mountain Wolf Recovery Plan. Denver, CO. 119 pp.

USDI Fish and Wildlife Service (USFWS). 1993. Grizzly bear recovery plan. Missoula, MT. 181 pp.

USDI Fish and Wildlife Service (USFWS). 1995. Endangered and Threatened Wildlife and Plants; Final Rule to Reclassify the Bald Eagle from Endangered to Threatened in all of the Lower 48 States. 50 CFR Part 17. *Federal Register*, Vol. 60, No. 133, July 12. pp. 35999-36010.

USDI Fish and Wildlife Service (USFWS). 1998 (revised 6/11/99). Draft: A Framework to Assist in Making Endangered Species Act Determination of Effect for Individual or Grouped Actions at the Bull Trout Subpopulation Watershed Scale. Adapted from the National Marine Fisheries Service, Coastal Salmon Conservation: Working guidance for comprehensive salmon restoration initiatives on the Pacific coast. September 1996.

USDI Fish and Wildlife Service (USFWS). 1999. Endangered and Threatened Wildlife and Plants; Proposed Rule to Remove the Bald Eagle in the Lower 48 States from the List of Endangered and Threatened Wildlife. 50 CFR Part 17. *Federal Register*, Vol. 64, No. 128. July 6. pp 36454-36464.

USDI Fish and Wildlife Service (USFWS). 2001. Concurrence letter from Mark R. Wilson, on maps of threatened and endangered species potential distribution on the KNF. 2 pp. (plus attachments). Montana Field Office, Helena, MT. Also cited as Wilson 2001. March 6.

USDI Fish and Wildlife Service (USFWS). 2002. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Portland, OR. Available at: <http://www.fws.gov/pacific/bulltrout/recovery.html>.

USDI Fish and Wildlife Service (USFWS). 2003a. Biological Opinion and Conference Opinion on the Effects to Grizzly Bear, Bull Trout, and Lynx from the Implementation of Proposed Actions Associated with Plans of Operation for the Sterling Mining Company Rock Creek Copper/Silver Mine. Montana Ecological Services Field Office. p. 123.

USDI Fish and Wildlife Service (USFWS). 2003b. Rock Creek Mine Biological Opinion: Endangered Species Act, Section 7 Consultation, Biological Opinion and Conference Opinion on the Effects to Grizzly Bear, Bull Trout, and Lynx from the Implementation of Proposed Actions Associated with Plans of Operation for the Sterling Mining Company Rock Creek Copper/Silver Mine. Kootenai National Forest, Mountain-Prairie Region. Accessed 10/3/2007. Available at: <http://www.fws.gov/mountain-prairie/endspp/rockcreek>.

USDI Fish and Wildlife Service (USFWS). 2003c. Endangered and Threatened Wildlife and Plants; notice of remanded determination of status for the contiguous United States distinct population segment of the Canada lynx; clarifications of findings; final rule. 50 CFR Part 17. *Federal Register* Vol. 68, No. 128. pp. 40076-40101.

USDI Fish and Wildlife Service (USFWS). 2005. Recovery outline for the contiguous United States distinct population segment of the Canada Lynx. Montana Ecological Services Field Office. Pp. 22.

USDI Fish and Wildlife Service (USFWS). 2006. Biological Opinion on the Effects to Grizzly Bears, Bull Trout, and Bull Trout Critical Habitat from the Implementation of Proposed Actions Associated with Plan of Operations for the Revett RC Resources Incorporated Rock Creek Copper/Silver Mine. Montana Ecological Services Field Office. p. 130.

USDI Fish and Wildlife Service (USFWS). 2007a. Supplement to the Biological Opinion on the Effects to Grizzly Bears, Bull Trout, and Bull Trout Critical Habitat from the Implementation of Proposed Actions Associated with Plan of Operations for the Revett RC Resources Incorporated Rock Creek Copper/Silver Mine. Montana Ecological Services Field Office. pp. 169.

USDI Fish and Wildlife Service (USFWS). 2007b. National Bald Eagle Management Guidelines. 23 pp.

USDI Fish and Wildlife Service (USFWS). 2007c. Biological Opinion on the Effects of the Northern Rocky Mountain Lynx Amendment on the Distinct Population Segment of Canada Lynx (*Lynx canadensis*) (Lynx) in the Contiguous United States. Montana Ecological Services Field Office. 95 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, and USDA Wildlife Services. 2001. Rocky Mountain Wolf Recovery 2000 Annual Report. T. Meier, (ed.). Ecological Services, Helena, MT. 35 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, and USDA Wildlife Services. 2002. Rocky Mountain Wolf Recovery 2001 Annual Report. T. Meier, (ed.). Ecological Services, Helena, MT. 43 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, and USDA Wildlife Services. 2003. Rocky Mountain Wolf Recovery 2002 Annual Report. T. Meier, (ed.). Ecological Services, Helena MT. 64 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, and USDA Wildlife Services. 2004. Rocky Mountain Wolf Recovery 2003 Annual Report. T. Meier, (ed.). Ecological Services, Helena MT. 65 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, and USDA Wildlife Services. 2005. Rocky Mountain Wolf Recovery 2004 Annual Report. D. Boyd, (ed.). Ecological Services, Helena MT. 72 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, Montana Fish, Wildlife and Parks, Idaho Department of Fish and Game, and USDA Wildlife Services. 2006. Rocky Mountain Wolf Recovery 2005 Annual Report. C. A. Sime and E. E. Bangs, (eds.). Ecological Services, Helena, MT. 130 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, Montana Fish, Wildlife and Parks, Idaho Department of Fish and Game, and USDA Wildlife Services. 2007. Rocky Mountain Wolf Recovery 2006 Annual Report. C. A. Sime and E. E. Bangs, (eds.). Ecological Services, Helena, MT. 235 pp.

USDI Fish and Wildlife Service (USFWS), Nez Perce Tribe, USDI National Park Service, Montana Fish, Wildlife and Parks, Blackfeet Nation, Confederated Salish and Kootenai Tribes, Idaho Department of Fish and Game, and USDA Wildlife Services. 2008. Rocky Mountain Wolf Recovery 2007 Interagency Annual Report. C.A. Sime and E. E. Bangs, (eds.). USFWS, Ecological Services, 585 Shepard Way, Helena, MT. 59601. 275pp.

Vinkey, R. 2003. An Evaluation of Fisher (*Martes pennanti*) Introductions in Montana. Missoula, MT: University of Montana. M.S. thesis, 97 pp.

Vinkey, R. M.K. Schwartz, K.S. McKelvey, K.R. Foresman, K.L. Pilgrim, B.J. Giddings, and E.C. LoFroth. 2006. When reintroductions are augmentations: the genetic legacy of fishers (*Martes pennanti*) in Montana. Journal of Mammalogy 87(2): 265-271.

Wakkinen, W. and W. Kasworm. 1997. Grizzly Bear and Road Density Relationships in the Selkirk and Cabinet-Yaak Recovery Zones. Idaho Department of Fish and Game (Bonners Ferry, ID) and USFWS. Libby, MT. 28 pp.

Wallace, J.B., J.W. Grubaugh, and M.R. Whiles. 1996. Biotic indices and stream ecosystem processes: results from an experimental study. Ecological Applications 6:140-151.

Warren, N. (tech. ed.) (USDA Forest Service). 1990. Old-growth habitats and associated wildlife species in the northern Rocky Mountains. USDA Forest Service, Missoula, MT. 47 pp.

Washington Water Power Company. 1996. Lower Clark Fork River Tributary Survey Final Report. Prepared for Cooperative Challenge Cost Share Project between Washington Water Power Company, USDA Forest Service, and Montana Fish, Wildlife, and Parks. Spokane, WA.

Waters, T.F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7. Bethesda, MD.

Watershed Consulting, LLC, and Kline Environmental Research, LLC. 2005. Montanore Project: R1/R4 Stream Habitat Surveys. Submitted to the KNF and the DEQ. p. 14 plus appendix.

Watson, G. and T.W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation at hierarchical scales. North American Journal of Fisheries Management 17(2):237-252.

Weaver, J.L., P.C. Paquet, and L.F. Ruggiero. 1996. Resilience and conservation of large carnivores in the Rocky Mountains. Conservation Biology 10(4):963-976.

Weaver, T.M. and J.J. Fraley. 1991. Fisheries habitat and fish populations. Flathead basin forest practices, water quality and fisheries cooperative program. Flathead Basin Commission, Kalispell, MT.

Weaver, T.M. and J.J. Fraley. 1993. A method to measure the emergence success of western cutthroat trout fry from varying substrate composition in a natural stream channel. North American Journal of Fisheries Management 13:817-822.

Wegner, S. 2006a. Senior Hydrologist. KNF. Personal communication with Jennifer Lynch, Aquatic Biologist, Chadwick Ecological Consultants, Inc. January 31.

Wegner, S. 2006b. Senior Hydrologist. KNF. Personal communication with Michael Galloway, senior hydrogeologist, regarding elevation of springs. ERO Resources Corporation. January.

Wegner, S. 2006c. Senior Hydrologist. KNF. Personal communication with Barbara Galloway, senior hydrologist, regarding rain-on-snow events. ERO Resources Corporation. July.

Wegner, S. 2006d. Senior Hydrologist. KNF. Personal communication with Barbara Galloway, senior hydrologist, regarding KNF surface water data. ERO Resources Corporation. July.

Wegner, S. 2007. Senior Hydrologist. KNF. Personal communication with Barbara Galloway, senior hydrologist, regarding streamflow measurements. ERO Resources Corporation. September.

Wegner, S. 2008. Senior Hydrologist. KNF. Personal communication with Barbara Galloway, senior hydrologist, regarding Ramsey Lake. ERO Resources Corporation. January.

Werner, J.K., B.A. Maxell, P. Hendricks, and D. Flath. 2004. Amphibians and Reptiles of Montana. Mountain Press Publishing Company. Missoula, MT. pp. 262.

Westech Environmental Services, Inc. 2005a. Addendum to the wildlife baseline report, Montanore Project. Prepared for Mines Management Inc. Submitted to the KNF and the DEQ. November. p. 29 plus appendices.

Westech Environmental Services, Inc. 2005b. Noxious weed update 2005, Montanore Project. Submitted to the KNF and the DEQ. p. 6 plus appendix.

Westech Environmental Services, Inc. 2005c. Sensitive plant species assessment 2005, Montanore Project. Submitted to the KNF and the DEQ. p. 14 plus appendices.

Westech Environmental Services, Inc. 2005d. Vegetation update, Montanore Project. Submitted to the KNF and the DEQ. p. 40 plus appendices.

Westech Environmental Services, Inc. 2005e. Waters of the U.S. redelineation, Montanore Project. Submitted to the KNF and the DEQ. p. 24 plus appendices.

Western Economic Services, LLC. 2005. 2005 Hard Rock Mining Impact Plan for the Mines Management, Inc. Montanore Project. Submitted to the KNF and the DEQ. p. 48.

Western Economic Services, LLC. 2006. 2005 Socioeconomic report for the Mines Management Montanore Project. Submitted to the KNF and the DEQ. p. 166.

Western Resource Development Corporation. 1989a. Aquatic biology study, Montana Project 1990. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-1. p. 239 plus appendices.

Western Resource Development Corporation. 1989b. Baseline soils study, Montana Project 1989. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix F. p. 121 plus appendices.

Western Resource Development Corporation. 1989c. Addendum, baseline soils study, Montana Project 1989. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix F. p. 36.

Western Resource Development Corporation. 1989d. Baseline vegetation study, Montana Project 1989. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix E. p. 141 plus appendices.

Western Resource Development Corporation. 1989e. Addendum, baseline vegetation study, Montana Project 1989. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix E. p. 104.

Western Resource Development Corporation. 1989f. Wildlife baseline report, Montana Project, 1989. *In* Amended application for a hard rock operating permit and amended plan of operations. Lincoln and Sanders counties, MT. Prepared for Noranda Minerals Corporation. Mines Management, Inc. Appendix C. p. 175.

Western Technology and Engineering, Inc. 1991. Montanore Project, Aquatic macroinvertebrate monitoring study 1990. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-1. p. 48.

Western Technology and Engineering, Inc. 1992. Montanore Project, Aquatic biological monitoring 1991. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-2. p. 93.

Western Technology and Engineering, Inc. 1993. Montanore Project, Aquatic biological interim monitoring 1992. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-2. p. 102 plus appendices.

Western Technology and Engineering, Inc. 1994. Montanore Project, Continued interim aquatic biological monitoring 1993. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-3. p. 102 plus appendices.

Western Technology and Engineering, Inc. and Phycologic, Inc. 1995. Montanore Project, Continued interim aquatic biological monitoring 1994. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix D-3. p. 112 plus appendices.

Weydemeyer, W. and D. Weydemeyer. 1928. The woodpeckers of Lincoln County, MT. The Condor 30:339-346.

Whitaker, J.O., C.E. Maser, and L.E. Keller. 1977. Food habits of bats of western Oregon. Northwest Sci. 51:46-55.

Wiederholm, T. 1989. Responses of aquatic insects to environmental pollution. pp. 508-557. *In* V.H. Resh and D.M. Rosenberg (eds.). The Ecology of Aquatic Insects. Praeger Scientific. New York, NY.

Wilhm, J.L. 1970. Range of diversity indicies in benthic macroinvertebrate populations. Journal of Water Pollution Control Federation 42:R227-R234.

Williams, J. 2006. Biologist, Montana Fish, Wildlife, and Parks. Personal communication with K. Baud, Wildlife Biologist, ERO Resources Corporation. KNF Project Record, Montanore Project. February 10.

Williams, J. 2008. Biologist, Montana Fish, Wildlife, and Parks. Personal communication with K. Baud, Wildlife Biologist, ERO Resources Corporation. September 22.

Wilson, A.H. 1972. Research into the Determination of Pillar Size, Part 1—An Hypothesis Concerning Pillar Stability. The Mining Engineer 131(141):409-417.

Witmer, G.W., S.K. Martin, and R.D. Sayler. 1998. Forest carnivore conservation and management in the interior Columbia basin: Issues and environmental correlates. USDA Forest Service, Pacific NW Res. Station, Portland, OR. General Technical Report PNW-GTR-420. 51 pp.

Wittinger, T, W. Kasworm, W. Waakinen, T. Manley, B. Summerfield, L. Young and B. Ralphs. 2002 (unpublished). Grizzly bear distribution outside of recovery zones. USDA Forest Service, Region 1, Missoula, MT. pp 2.

Woodward-Clyde Consultants, Inc. 1989a. Baseline air quality and meteorological studies, Montana Project. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix A. pp. 18.

Woodward-Clyde Consultants, Inc. 1989b. Air quality and meteorological baseline data collection, Montana Project. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix A. pp. 17.

Woodward-Clyde Consultants, Inc. 1989c. Baseline noise studies, Montana Project. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix H. pp. 11.

Woodward-Clyde Consultants, Inc. 1989d. Visual Resource Baseline Study, Montana Project. *In* Amended application for a hard rock operating permit and amended plan of operations. Mines Management, Inc. 2005. Appendix G. pp. 30.

Wright, V. 1996. Multiscale analysis of flammulated owl habitat use: owl distribution, habitat management, and conservation. M.S. thesis. University of Montana, Missoula, MT. 91 pp.

Wright, V., S.J. Hejl, and R.L. Hutto. 1997. Conservation implications of a multi-scale study of flammulated owls (*Otus flammeolus*) habitat use in the northern Rocky Mountains, USA. pp. 506-516. *In* J.R. Duncan, D.H. Johnson, and T.H. Nicholls, editors. Biology and Conservation of owls of the Northern Hemisphere. USDA Forest Service General Technical Report NC-190.

Figures For
Environmental Impact Statement For The
Montanore Project

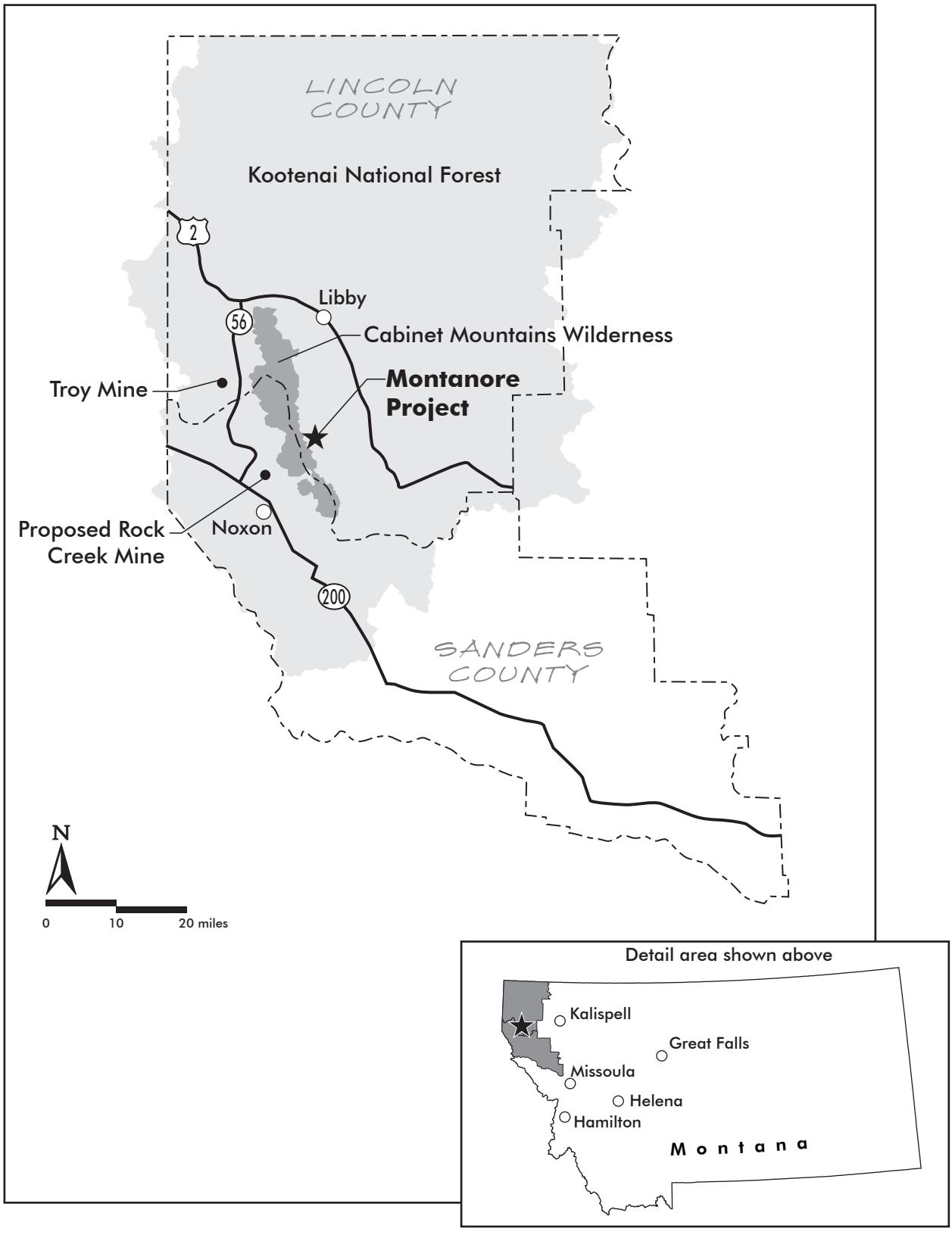


Figure 1. Location Map, Montanore Project, Kootenai National Forest.

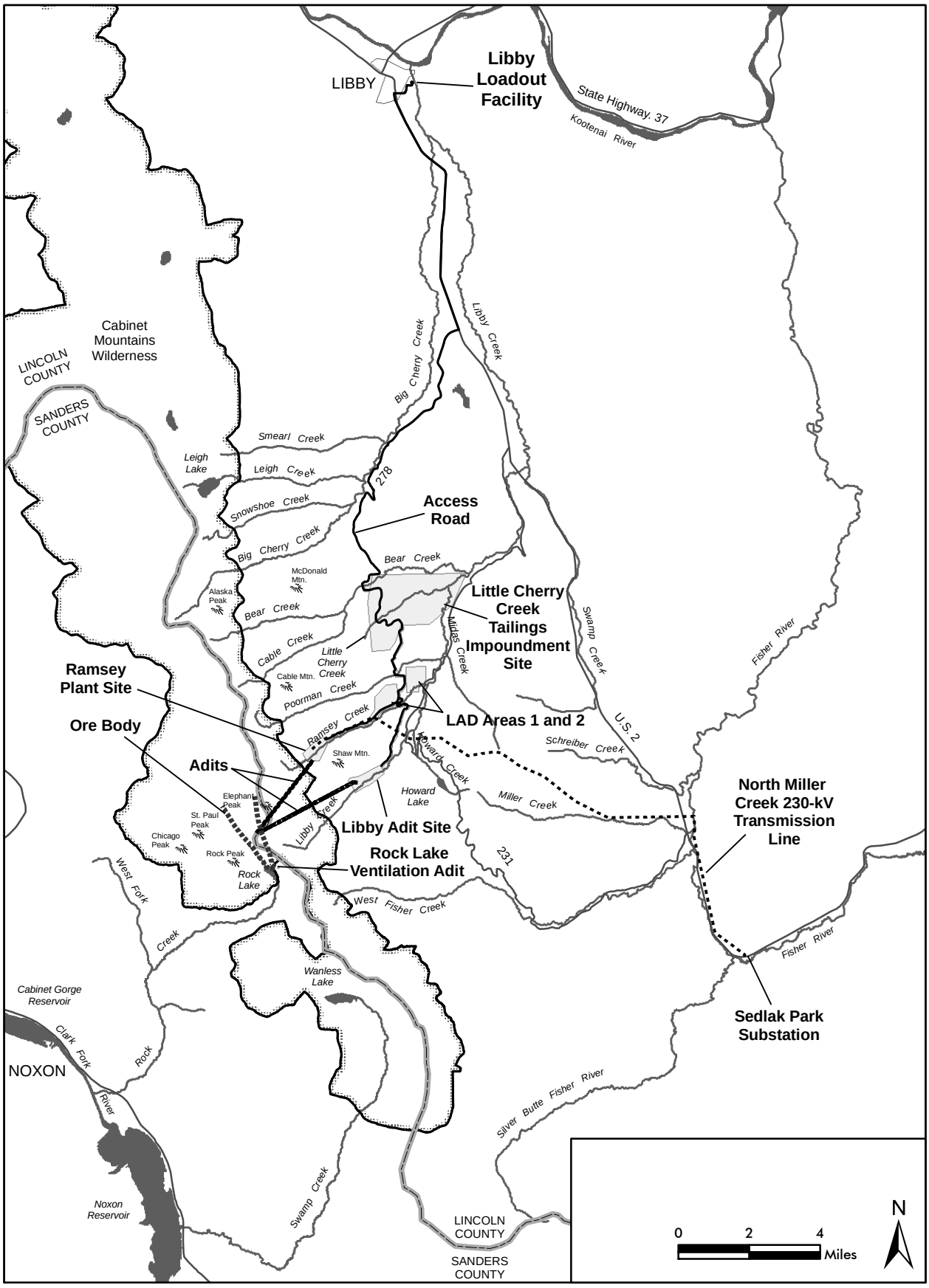


Figure 2. Location of Montanore Project Facilities, Alternative 2

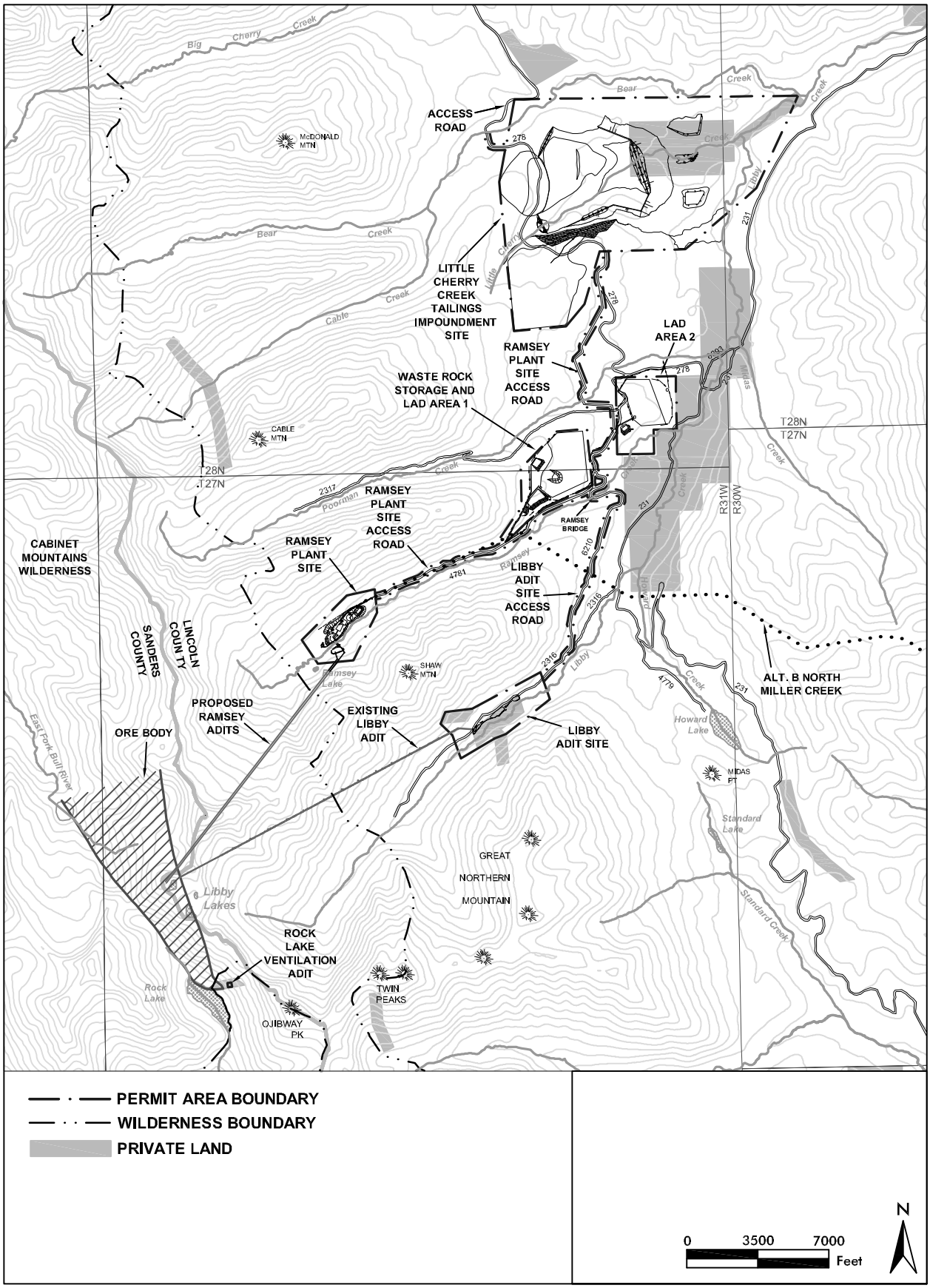


Figure 3. Mine Facilities and Permit Areas, Alternative 2

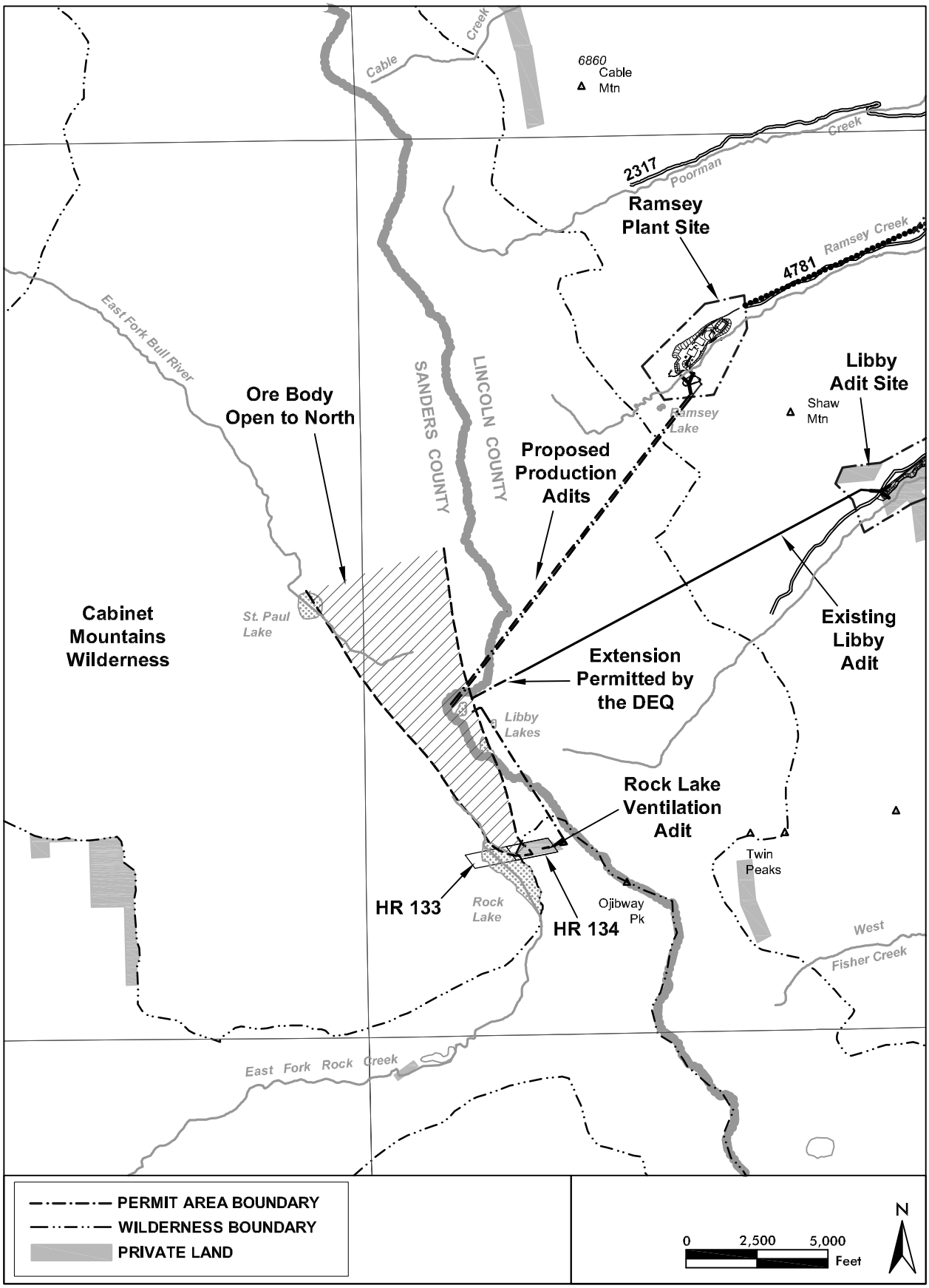


Figure 4. Existing Libby Adit and Proposed Ramsey Adits, Alternative 2

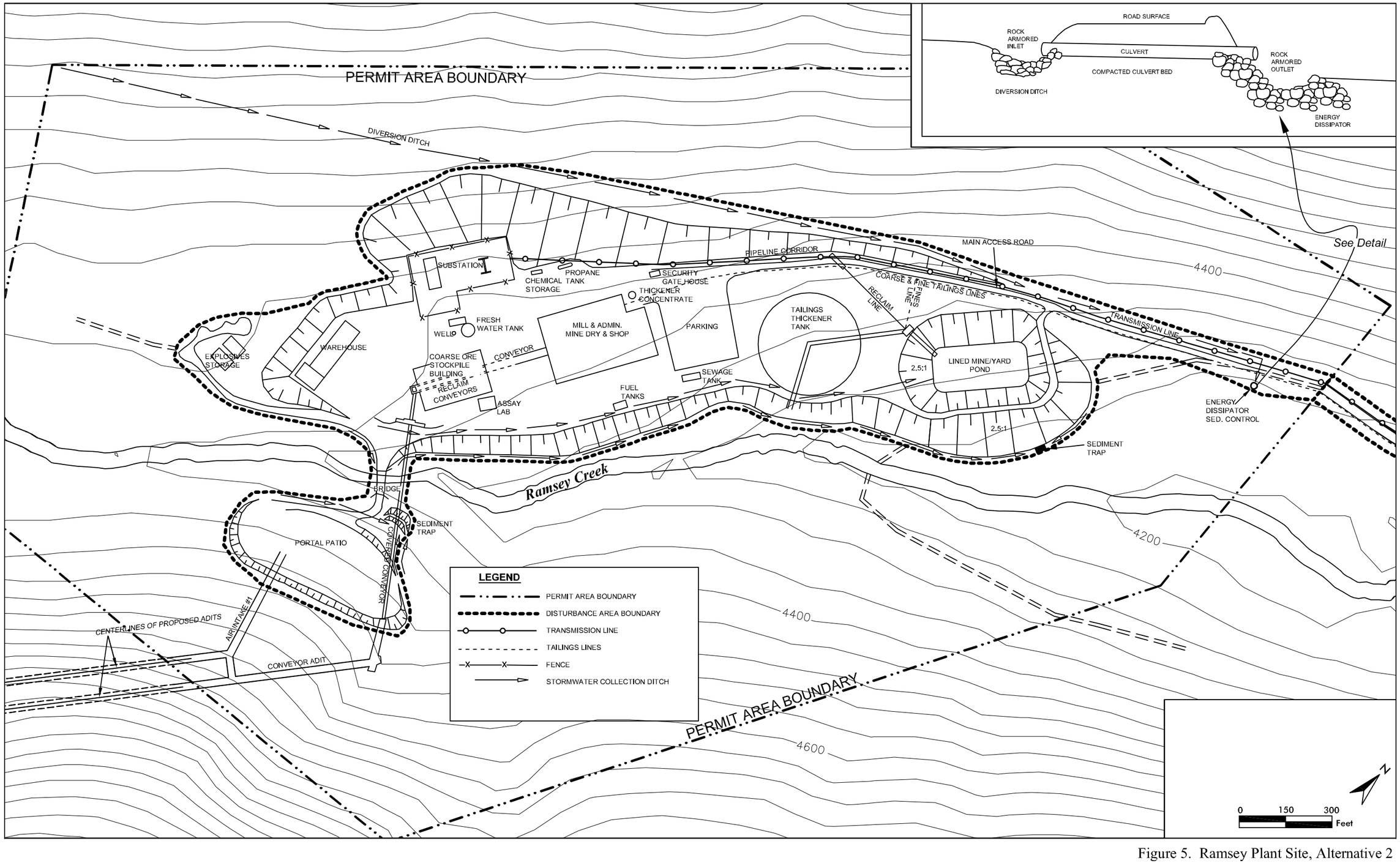


Figure 5. Ramsey Plant Site, Alternative 2

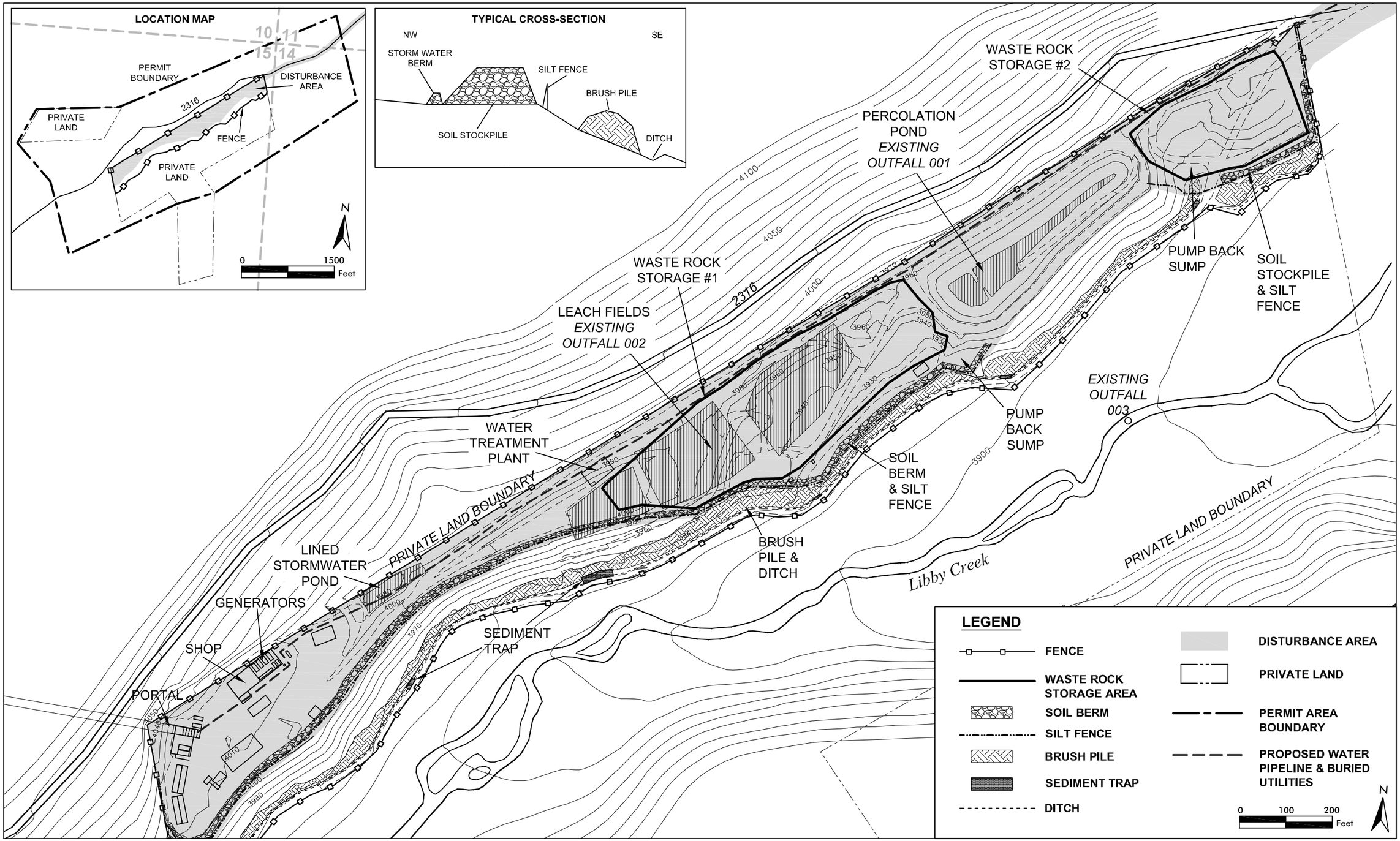


Figure 6. Existing and Proposed Libby Adit Site

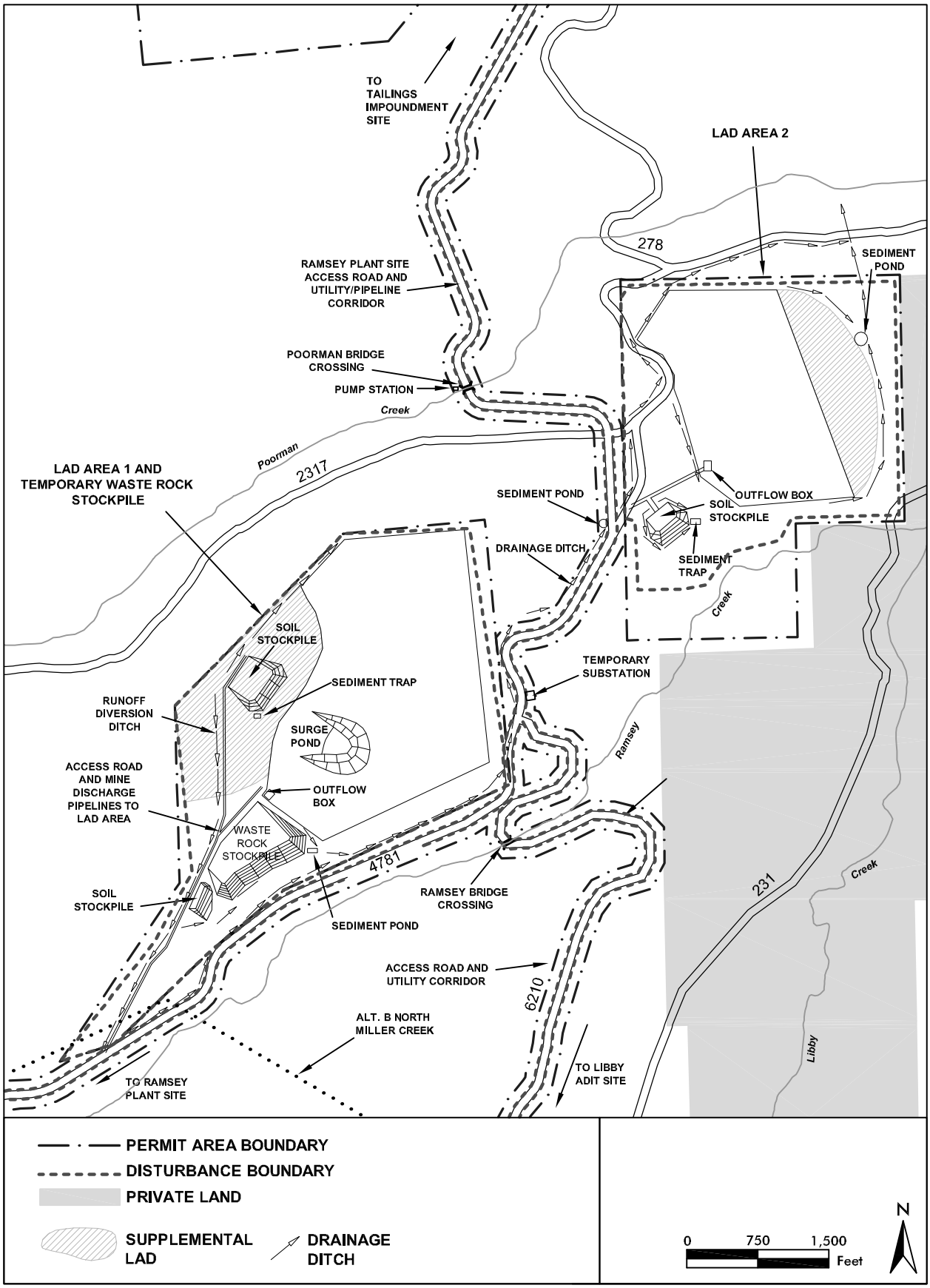


Figure 7. LAD Areas 1 and 2 and Waste Rock Stockpile, Alternative 2

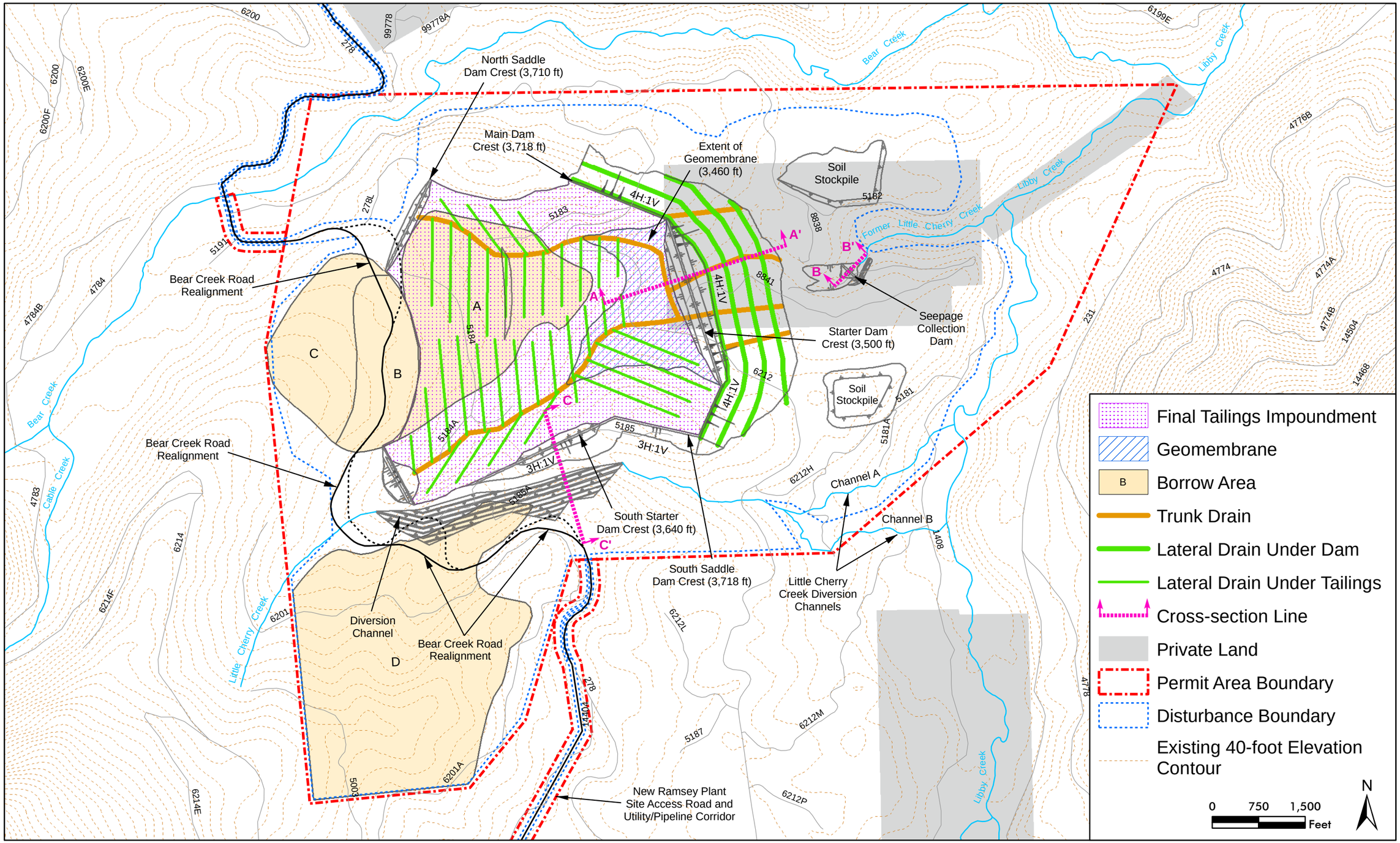


Figure 8. Little Cherry Creek Tailings Impoundment Site, Alternative 2

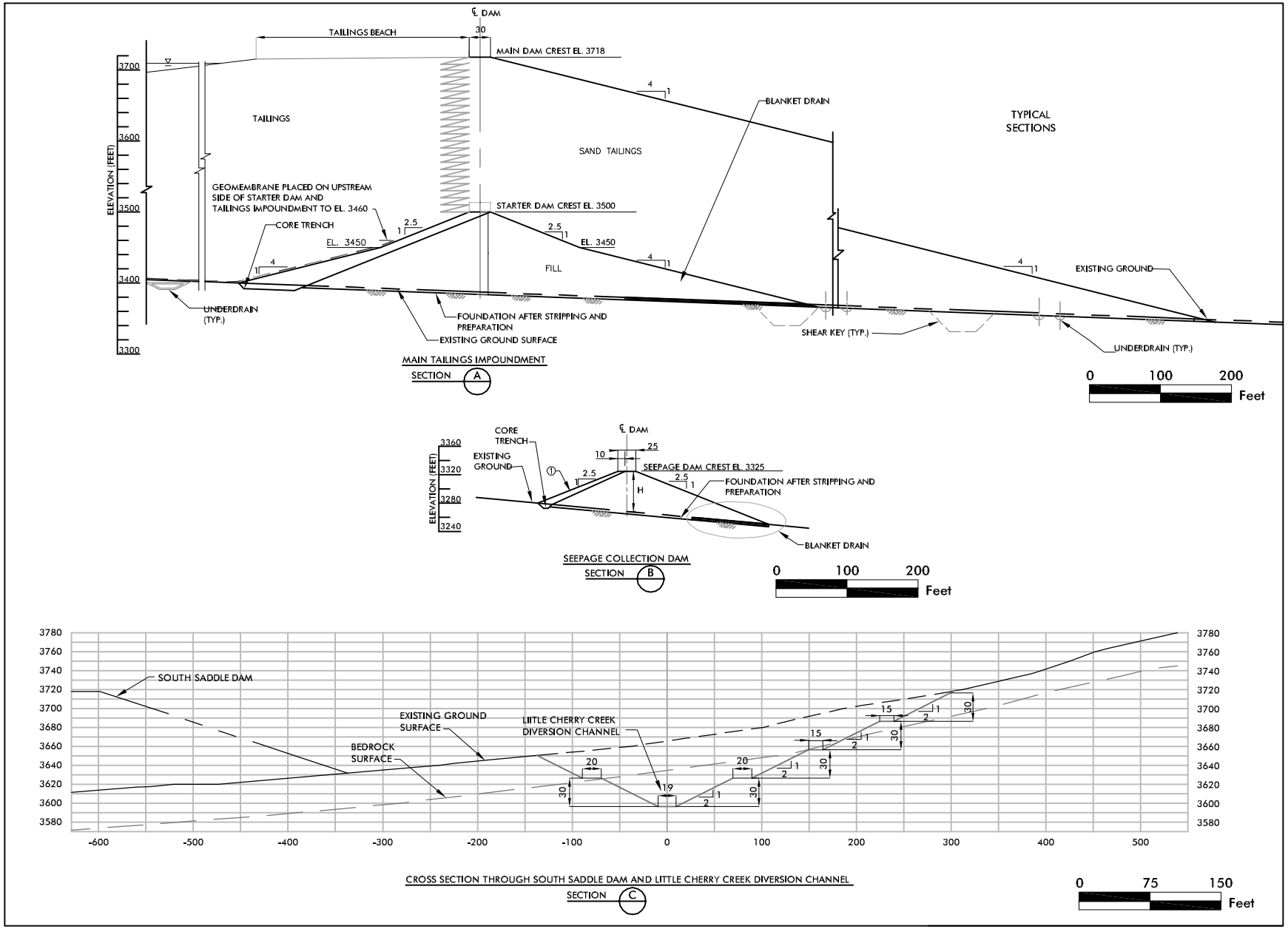


Figure 9. Little Cherry Creek Tailings Impoundment Cross Sections

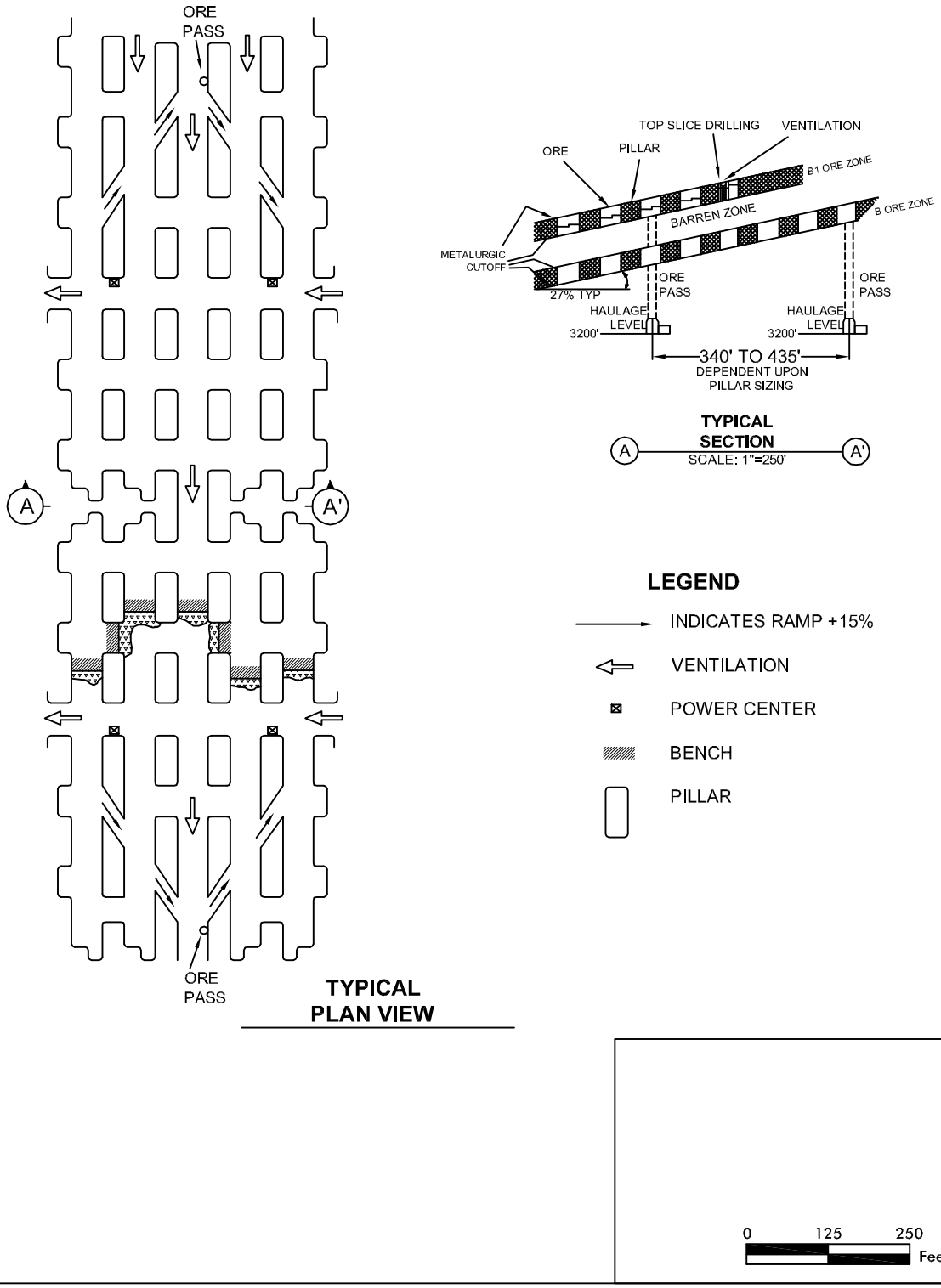


Figure 10. Room-and-Pillar Mining

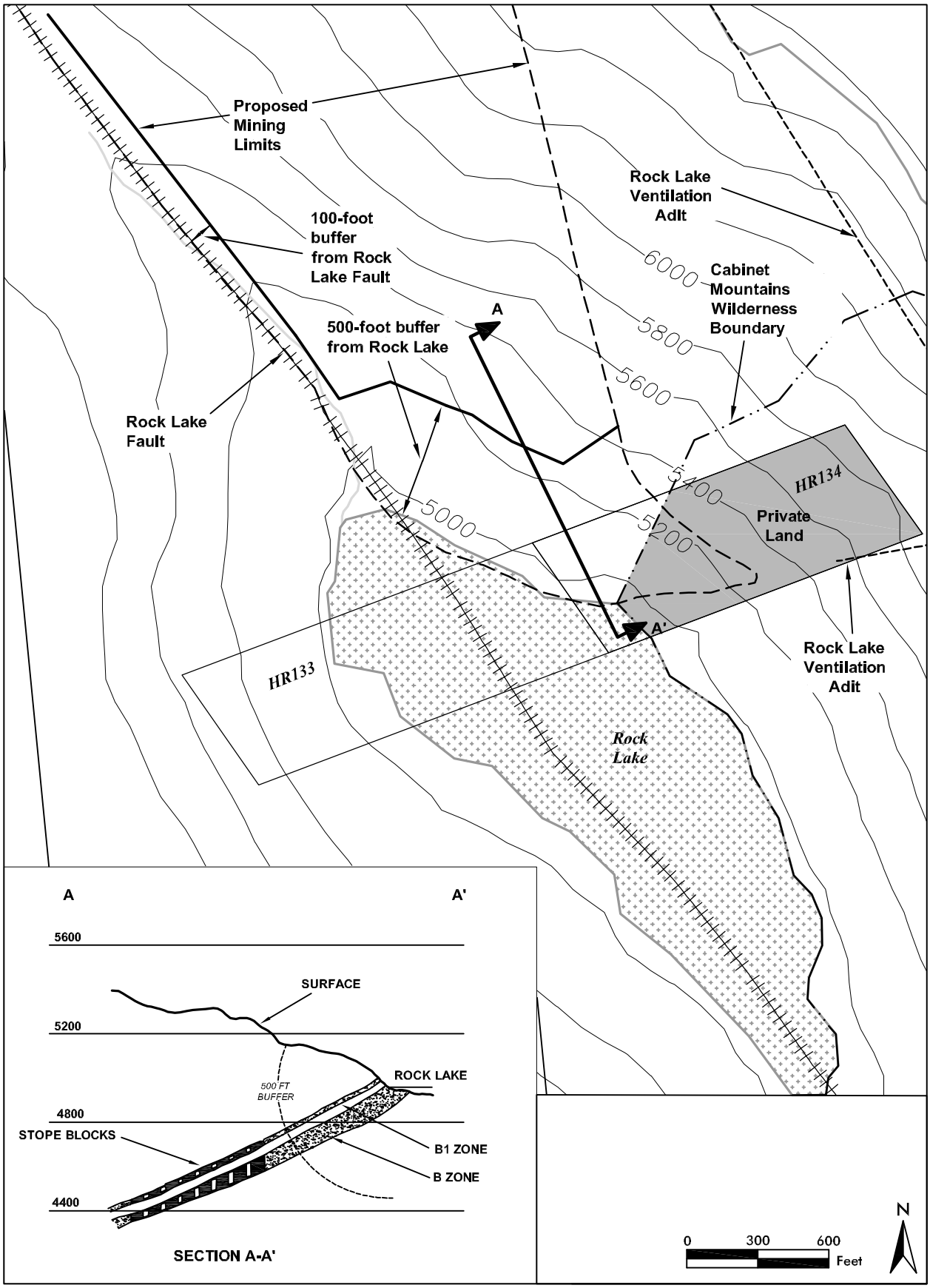


Figure 11. Relationship of the Ore Body to Rock Lake

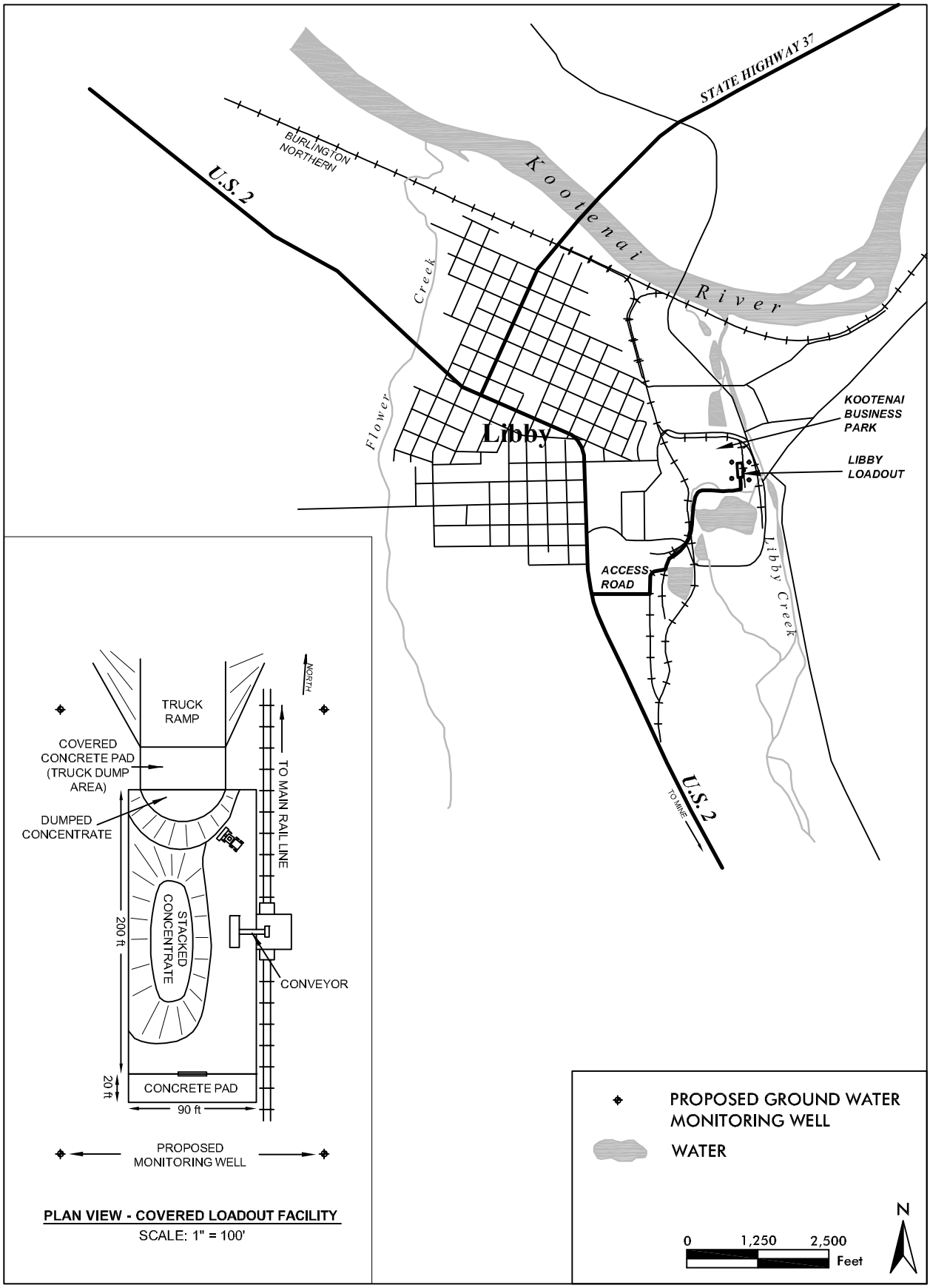
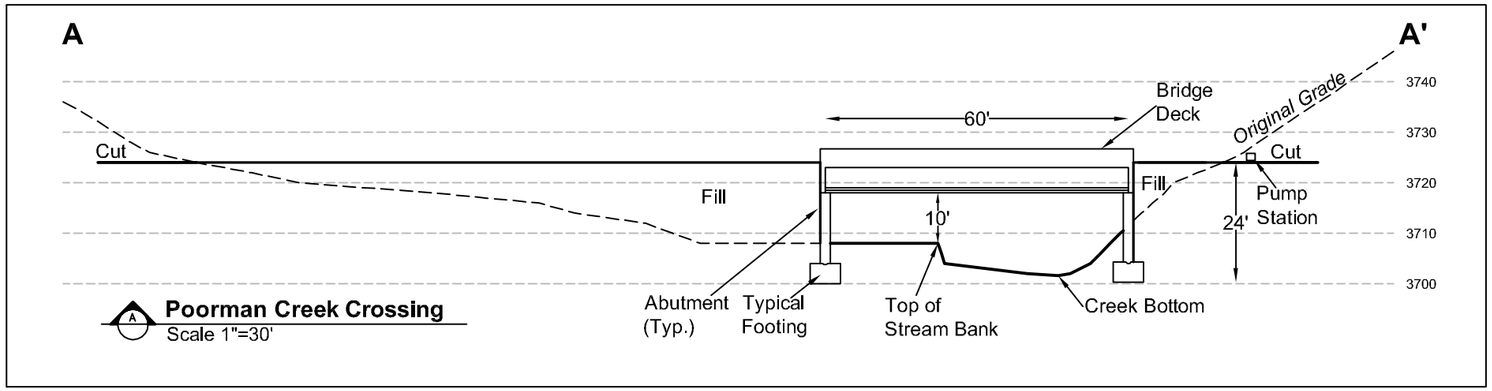
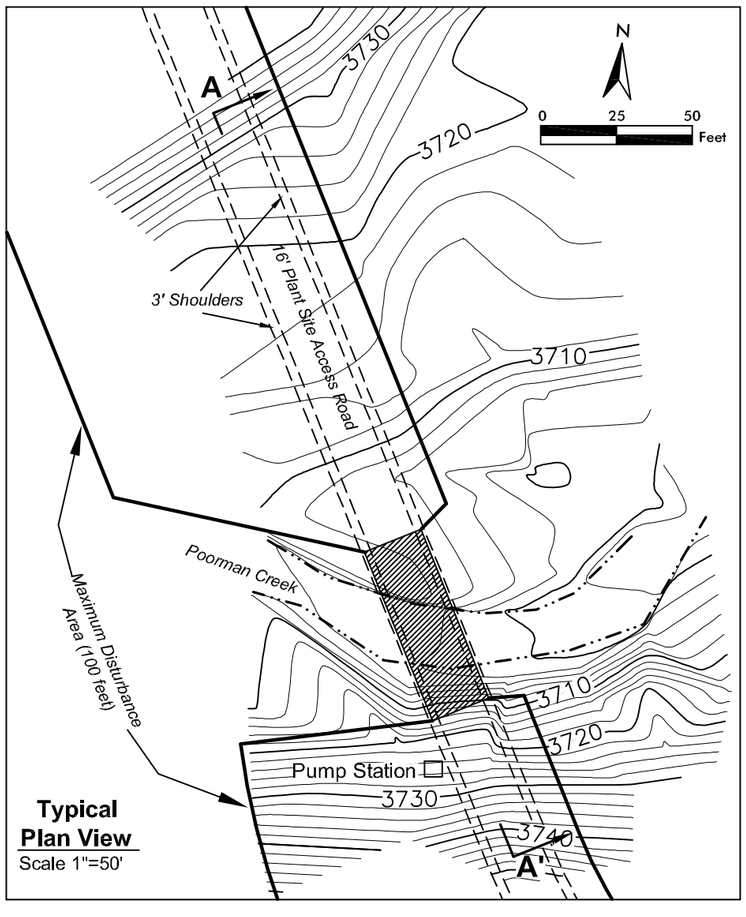
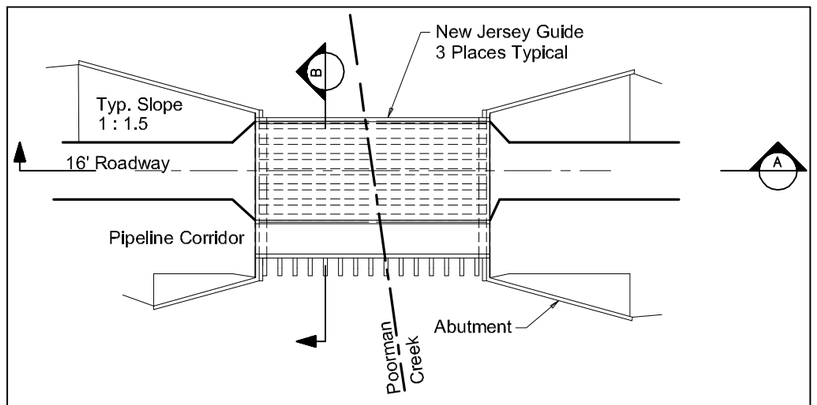
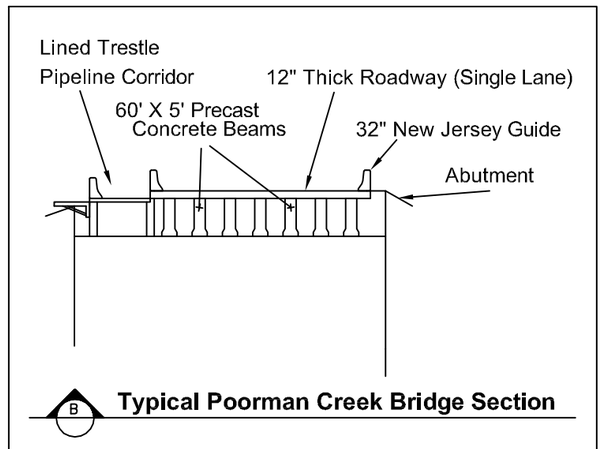


Figure 12. Libby Loadout









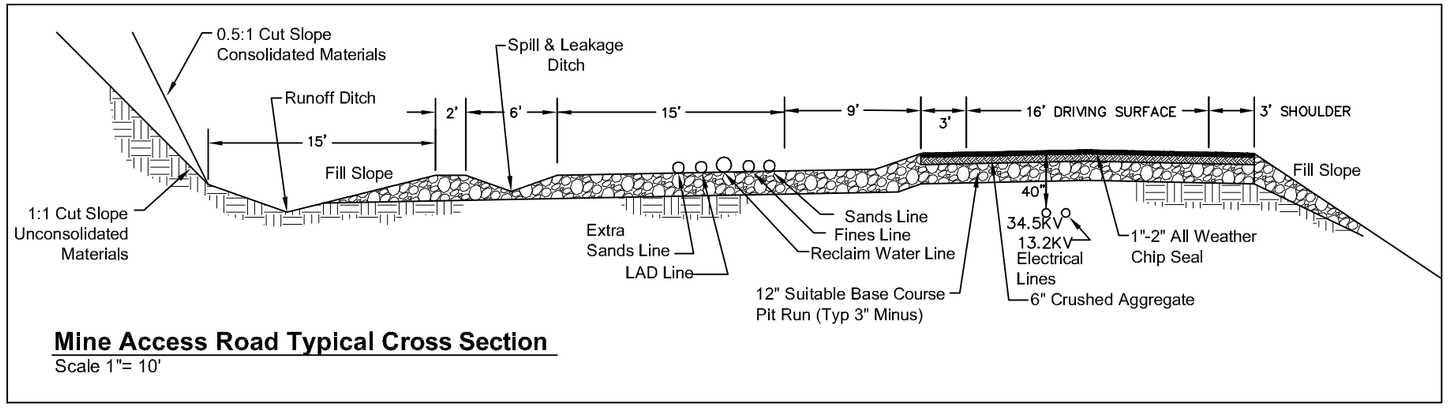


Figure 13. Details of Tailings Pipelines, Utility, and Access Road Corridor, Alternative 2

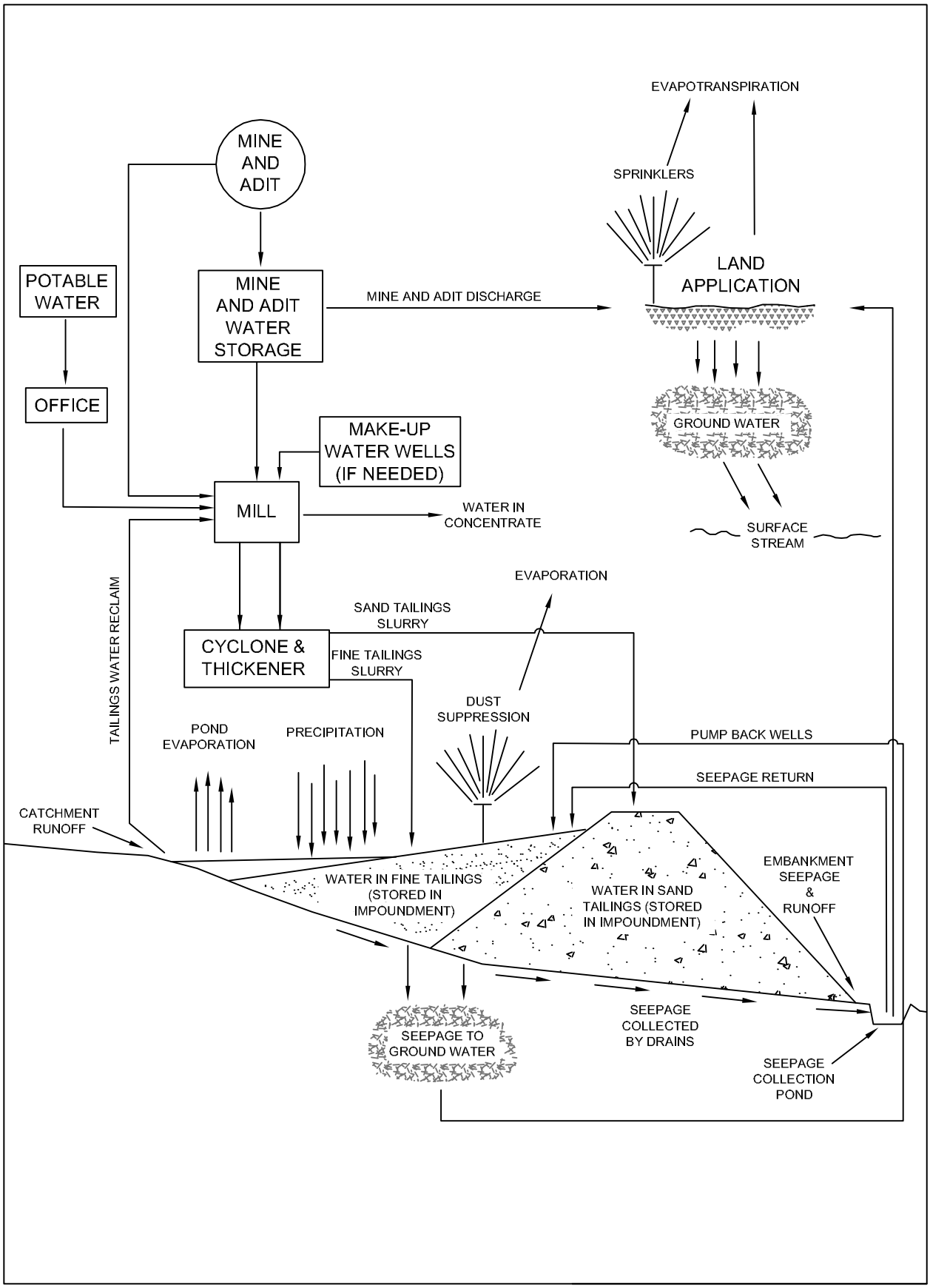


Figure 14. Proposed Water Management, Alternative 2

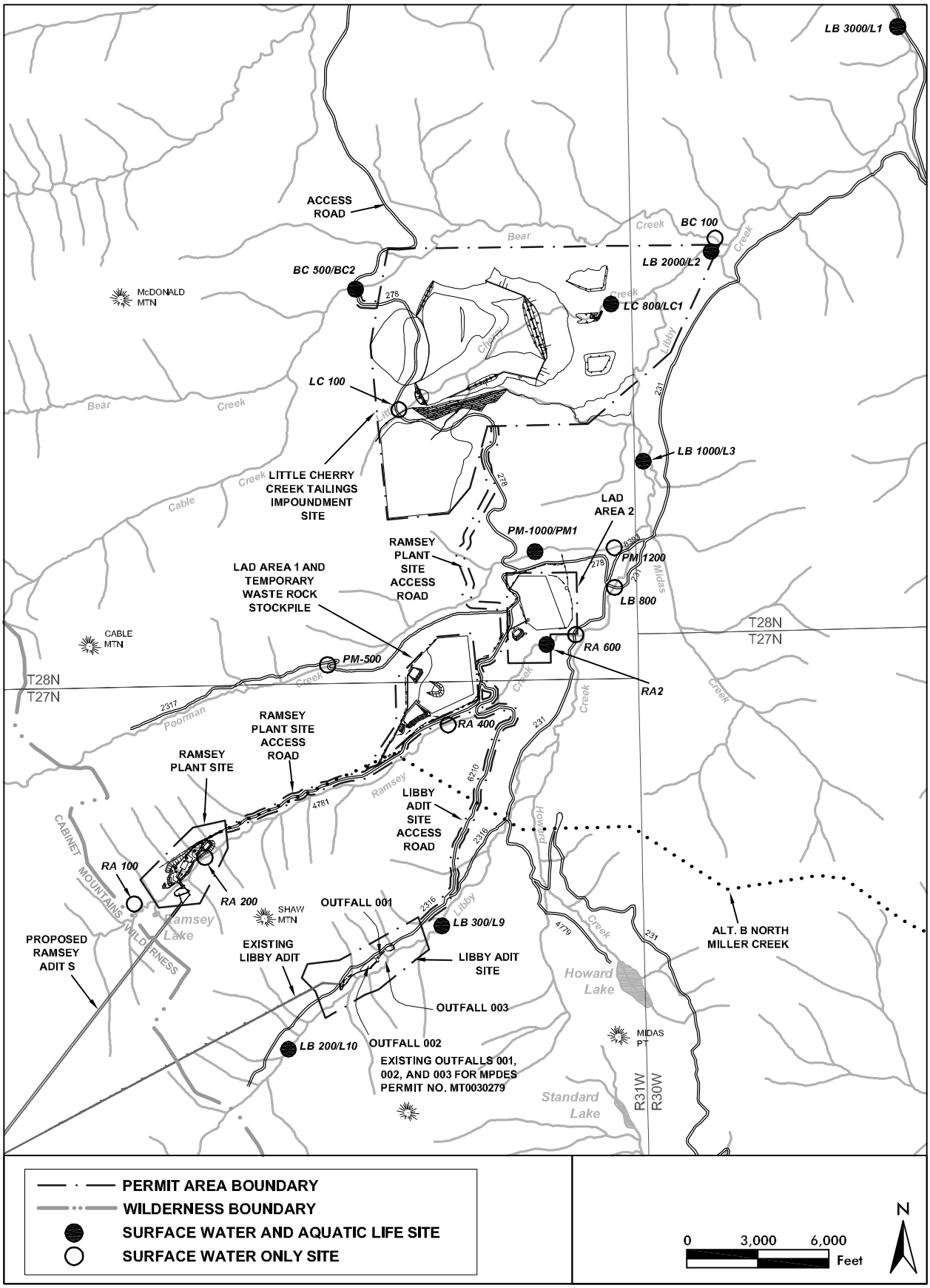


Figure 15. Existing Outfalls and Surface Water Monitoring Locations, Alternative 2

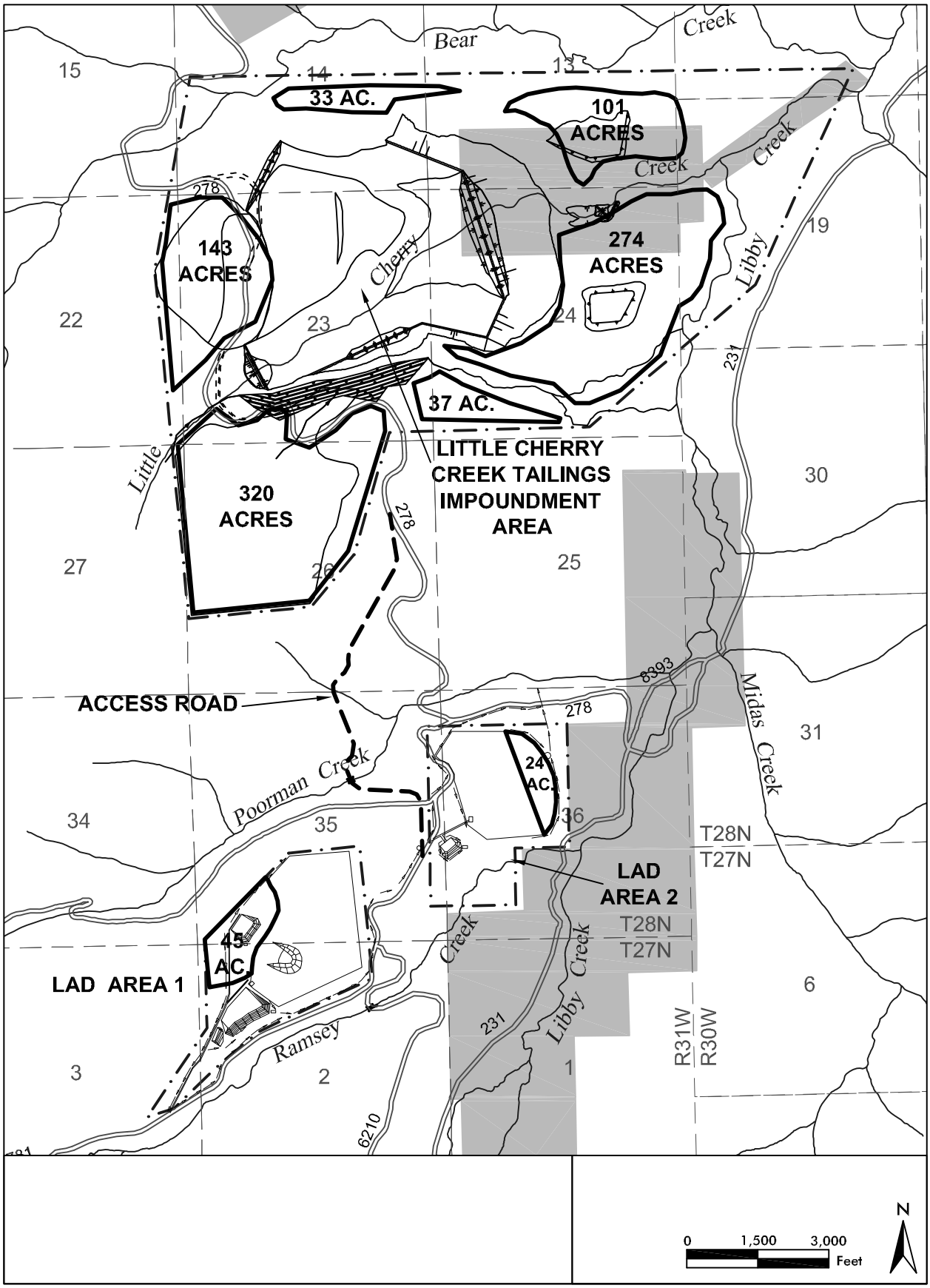


Figure 16. Supplemental LAD Areas, Alternative 2

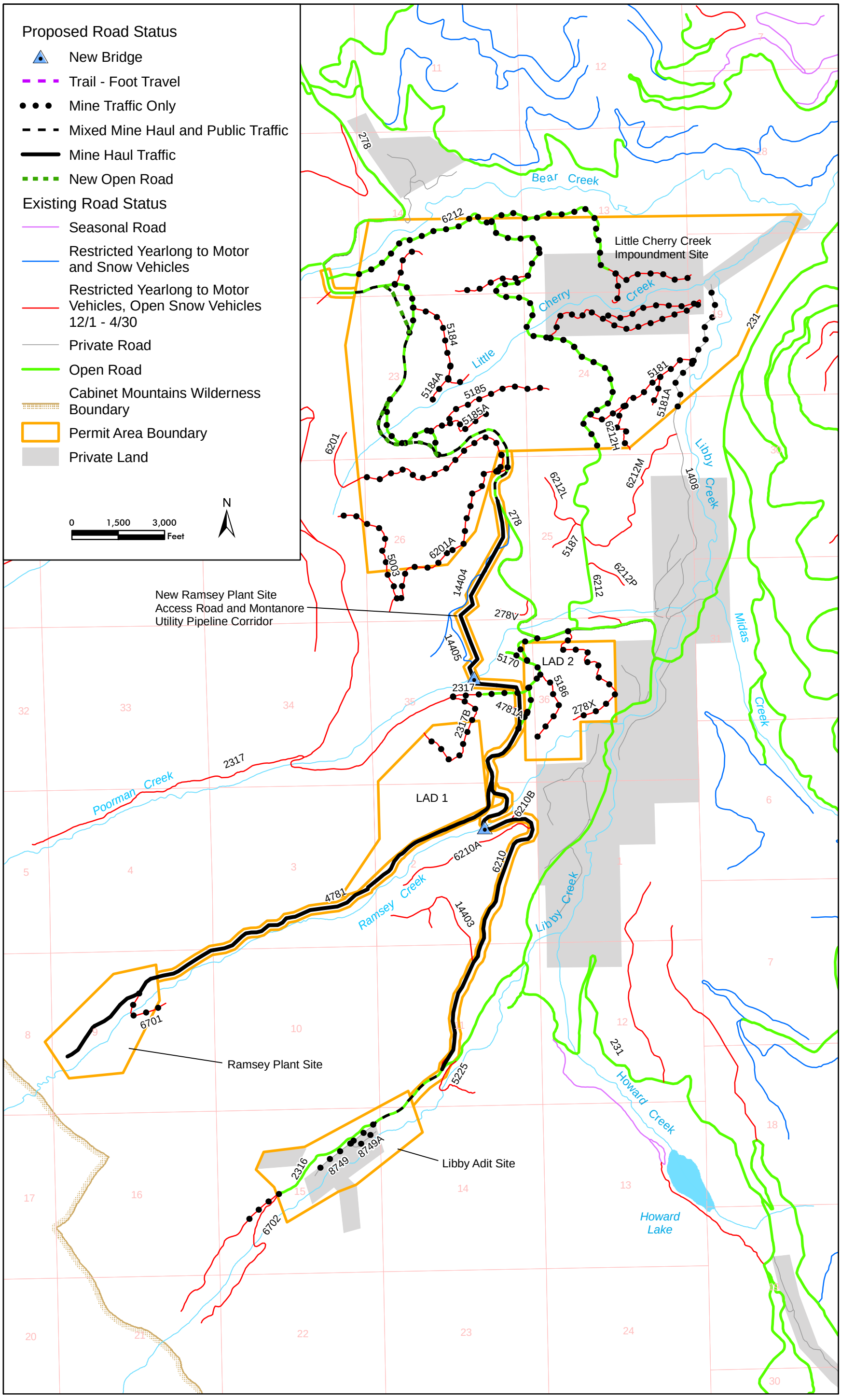


Figure 17. Roads Proposed for Use in Alternative 2

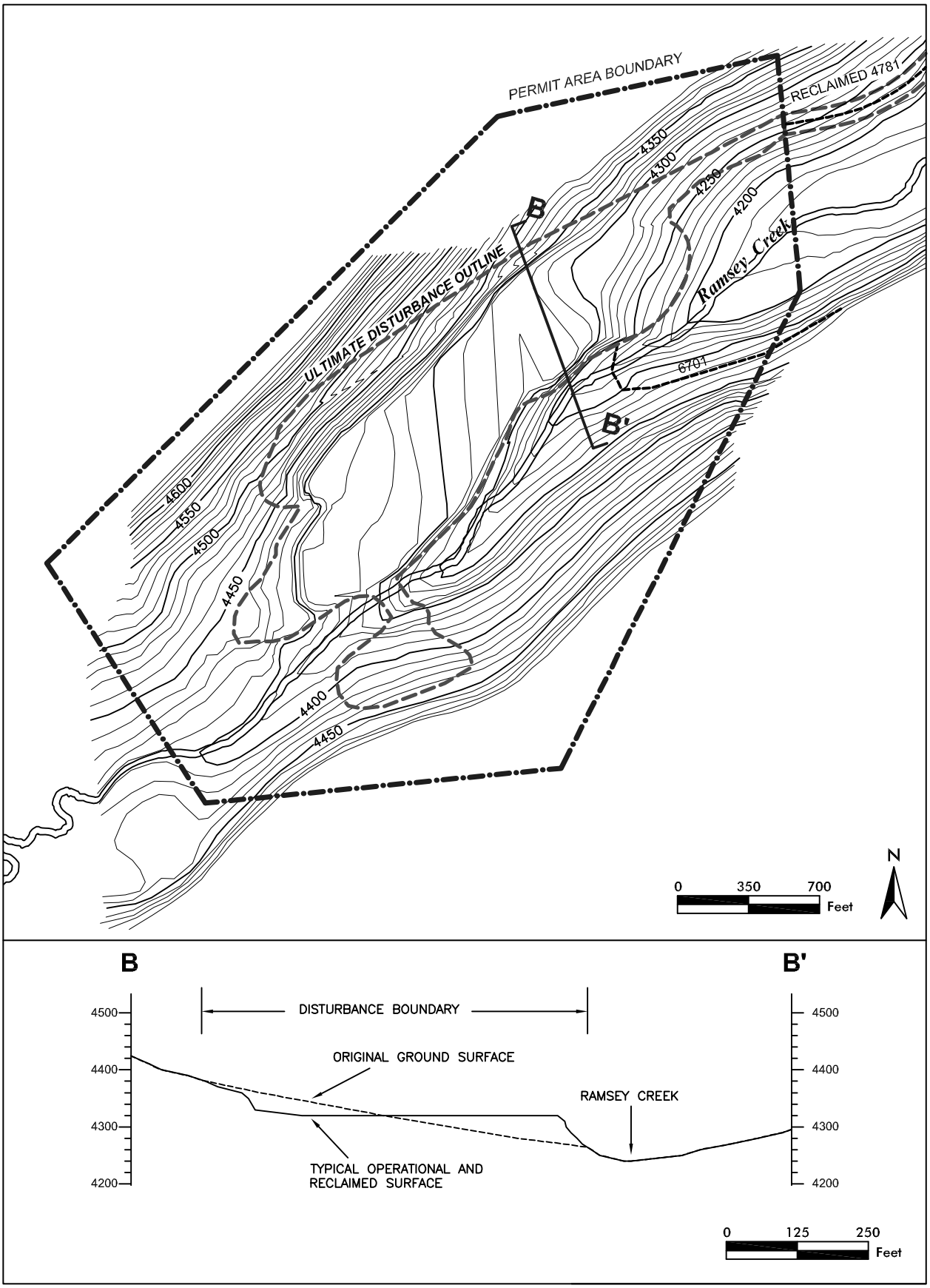


Figure 18. Post-mining Topography, Ramsey Plant Site, Alternative 2

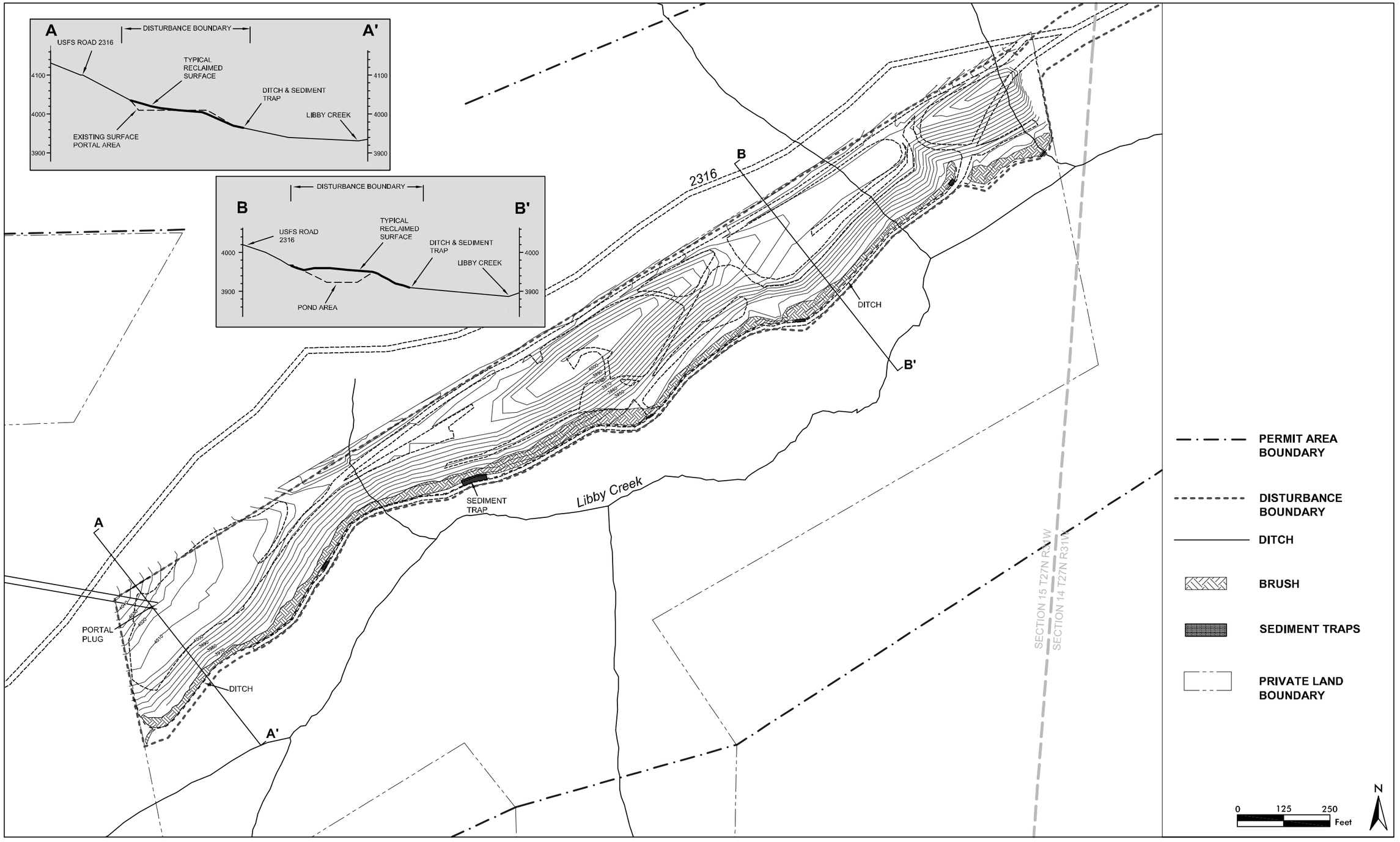


Figure 19. Post-mining Topography, Libby Adit Site

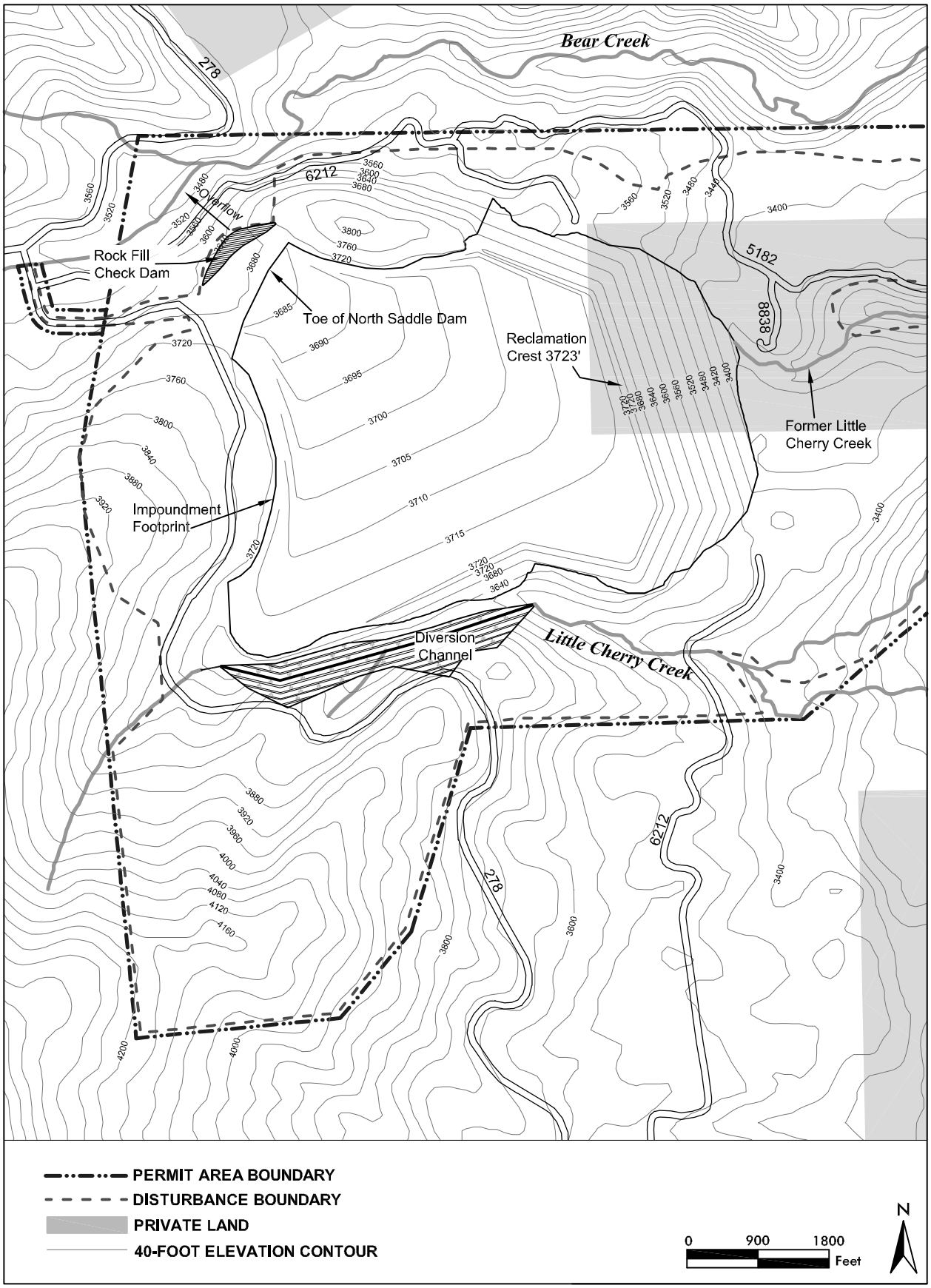


Figure 20. Post-mining Topography, Little Cherry Creek Tailings Impoundment Site, Alternative 2

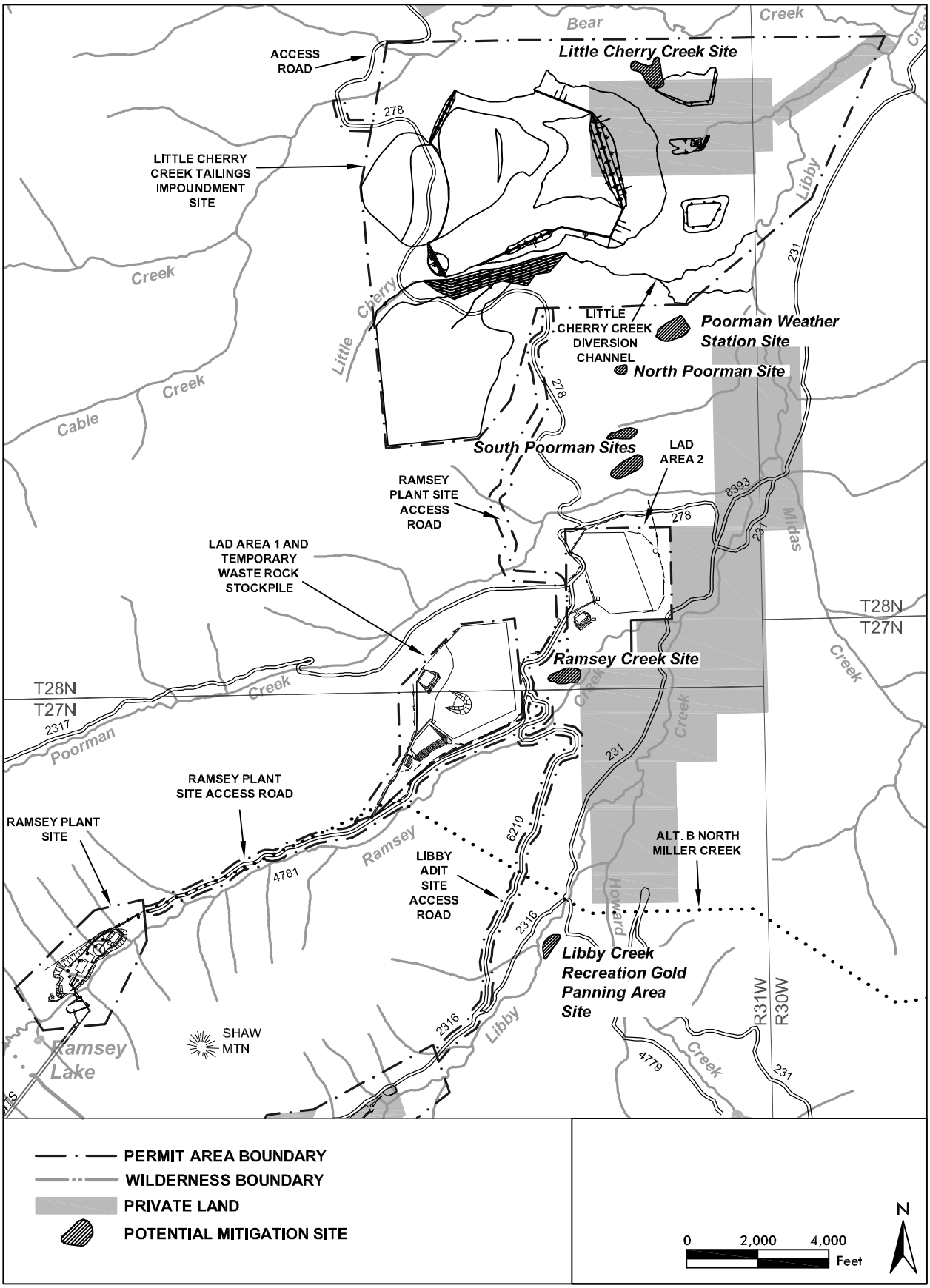


Figure 21. Potential Wetland Mitigation Sites, Alternative 2

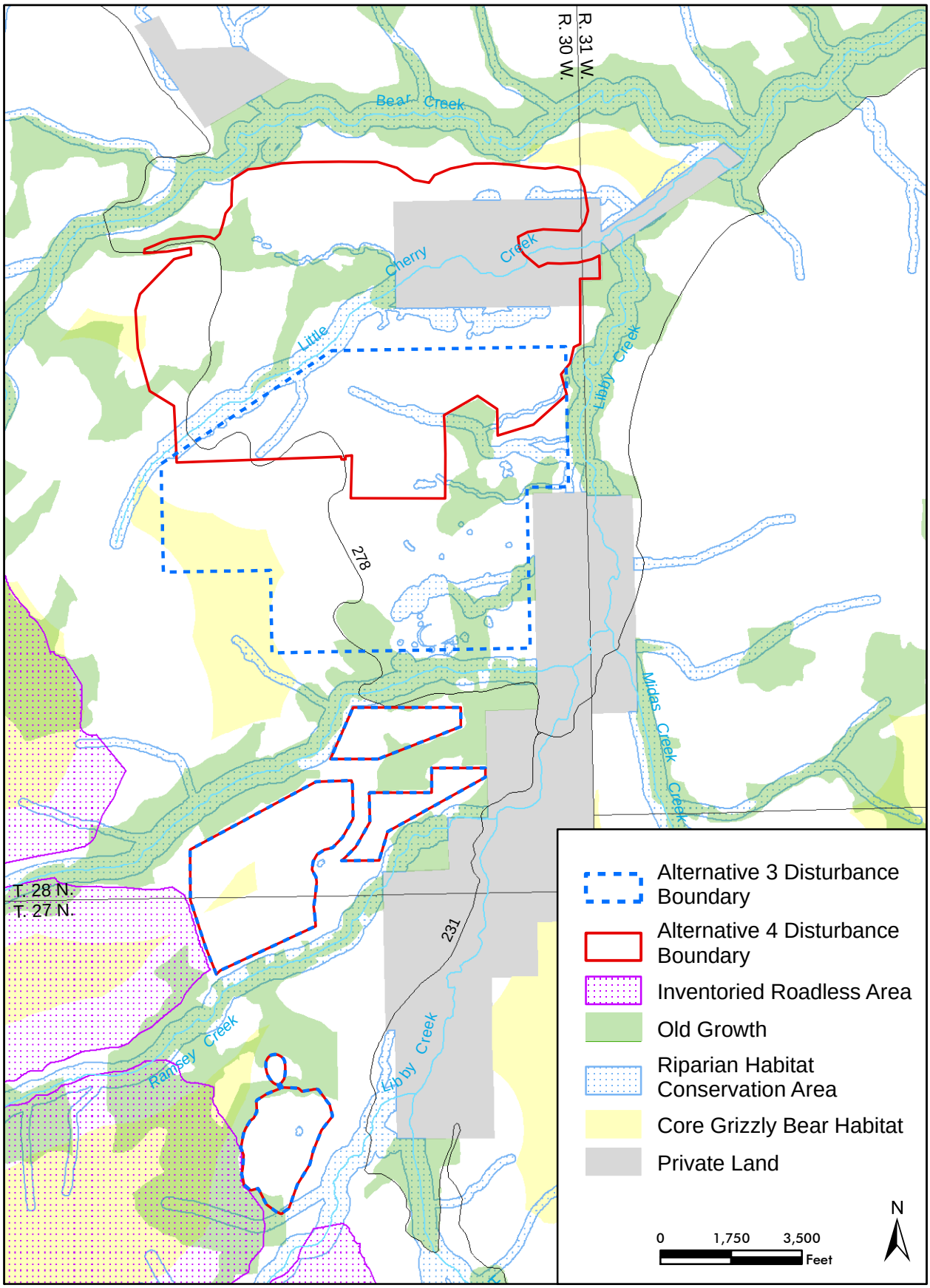


Figure 22. Key Resources Avoided by Alternatives 3 and 4

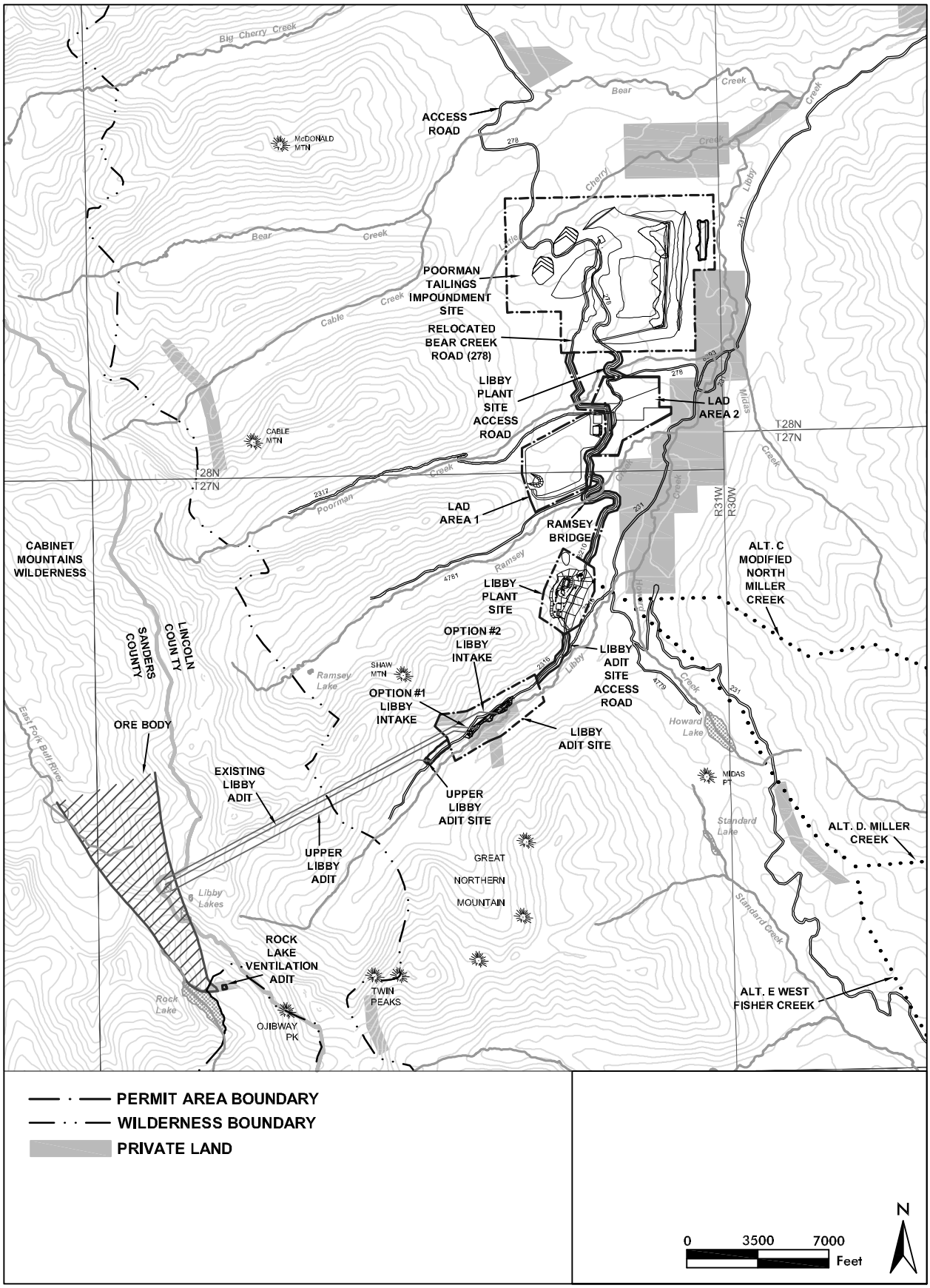


Figure 23. Mine Facilities and Permit Areas, Alternative 3

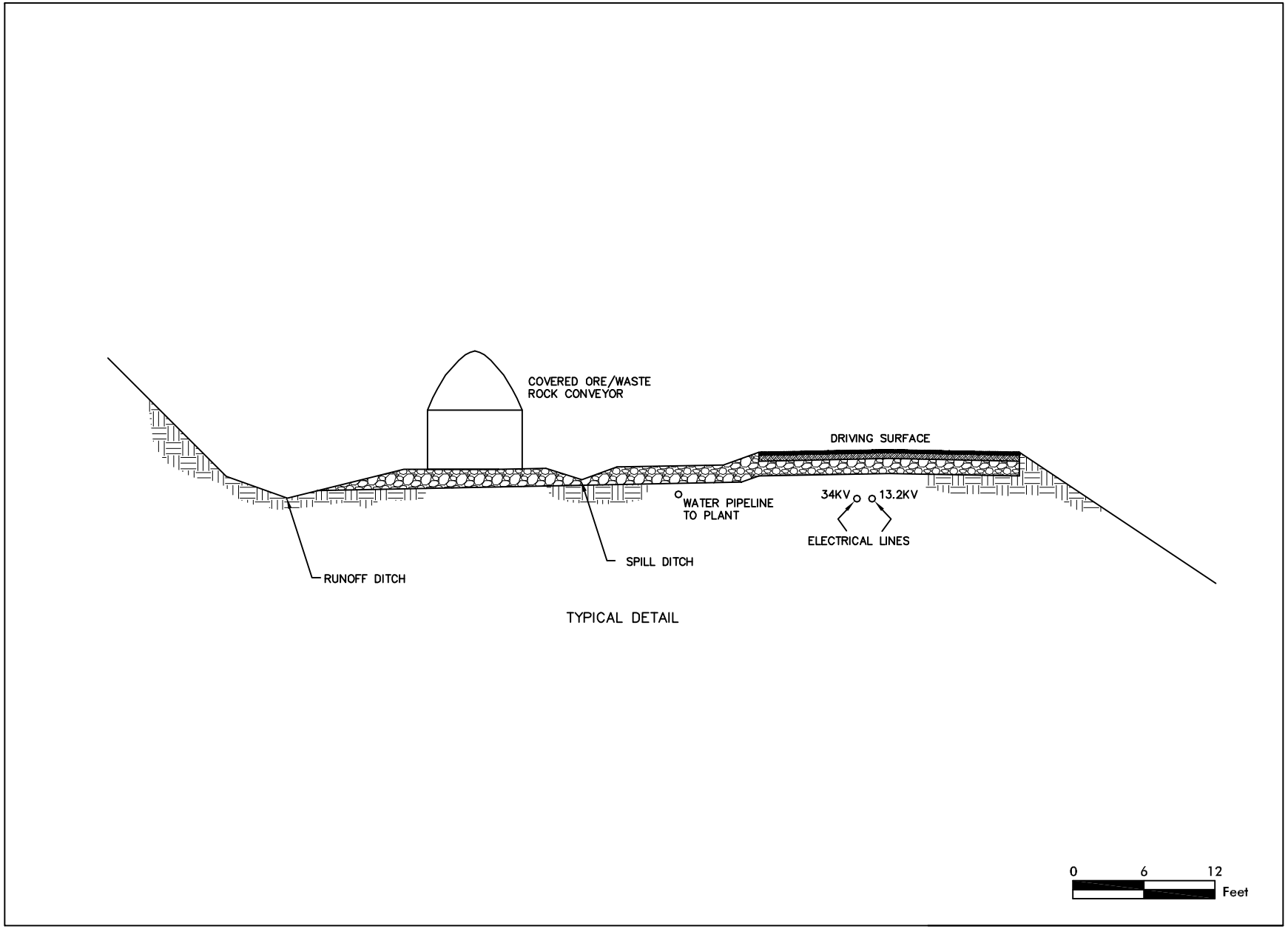


Figure 24. Detail of Overland Conveyor and Libby Adit Access Road, Alternatives 3 and 4

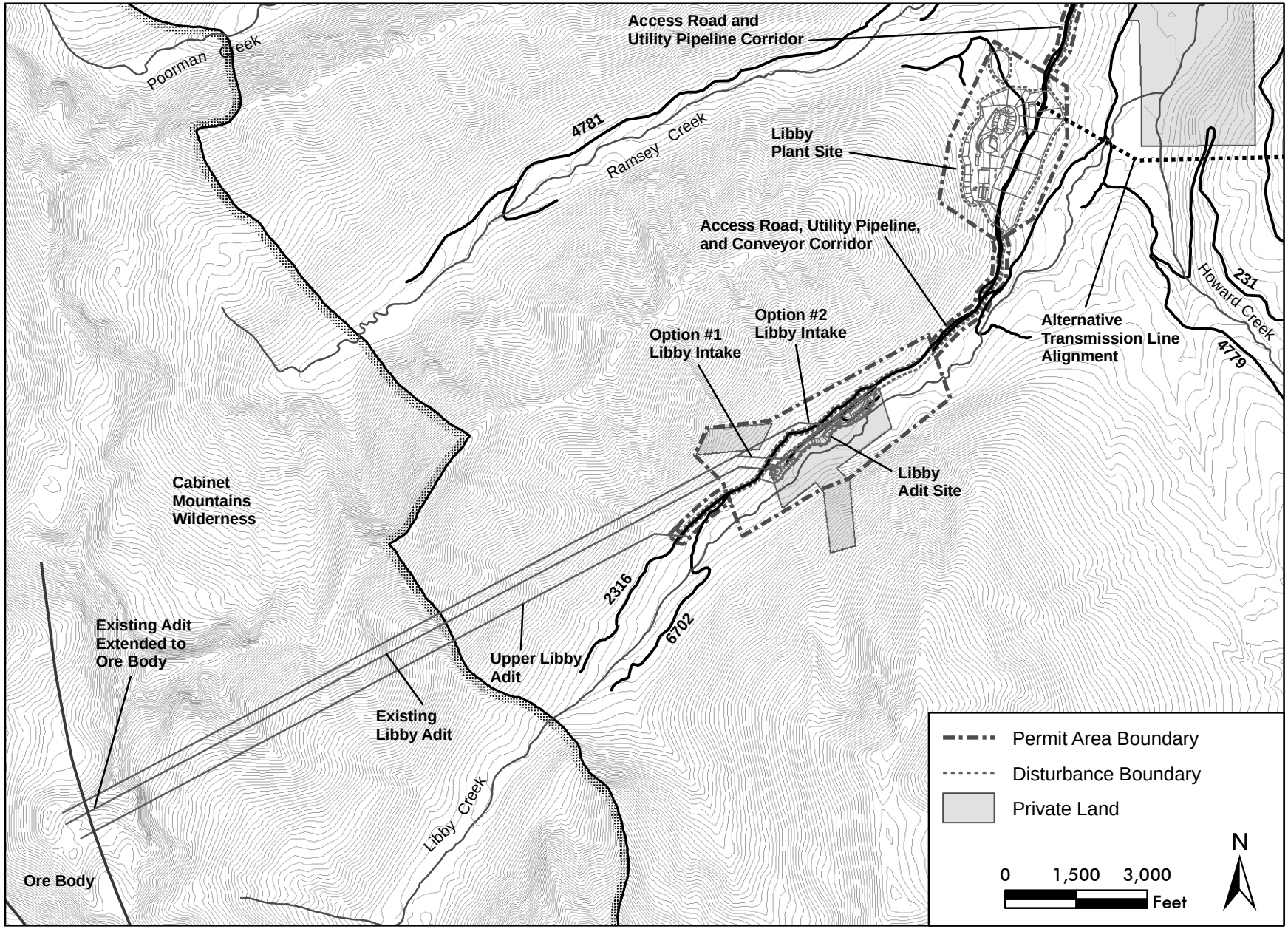


Figure 25. Libby Plant Site and Adits, Alternatives 3 and 4

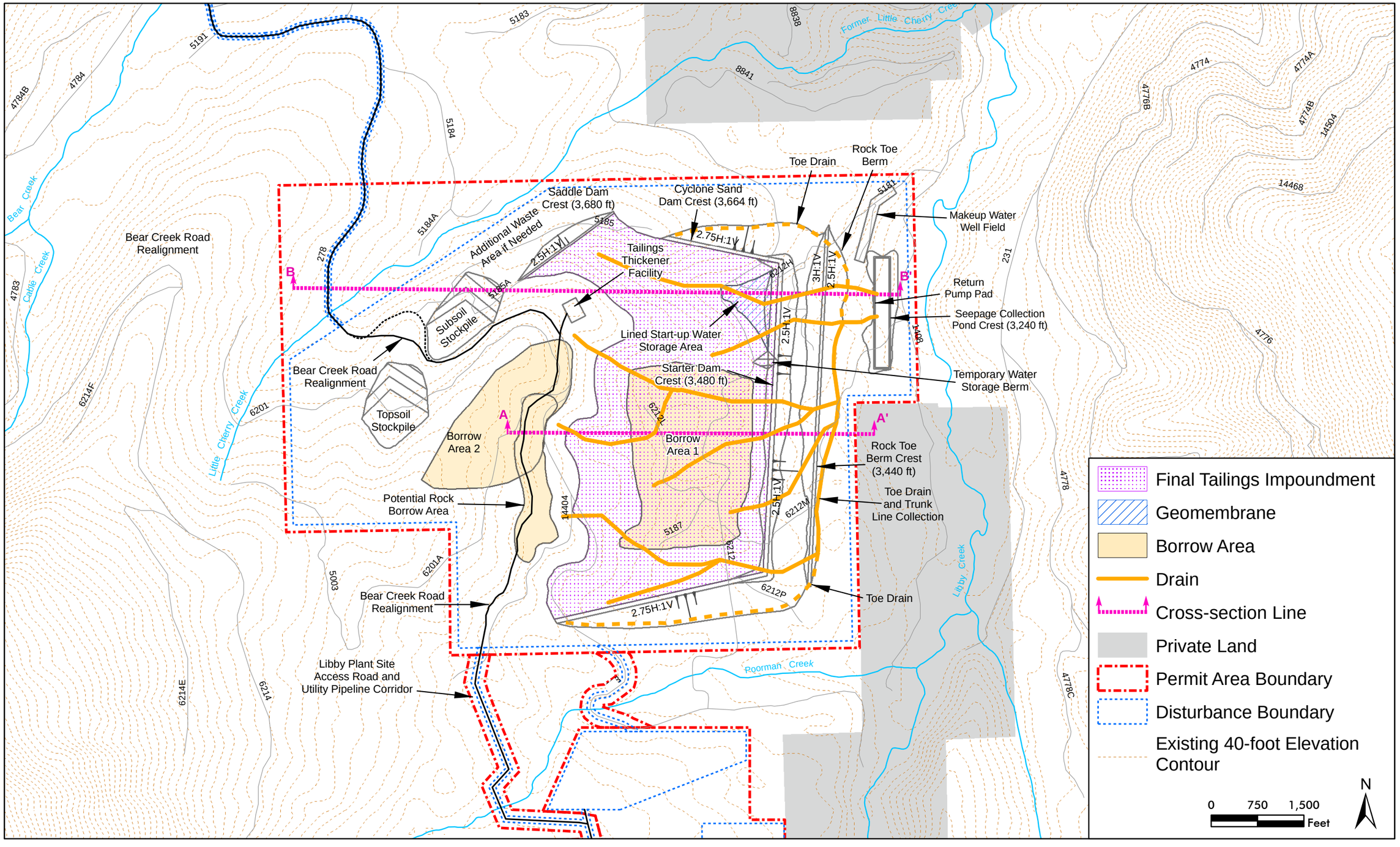


Figure 26. Poorman Tailings Impoundment Site, Alternative 3

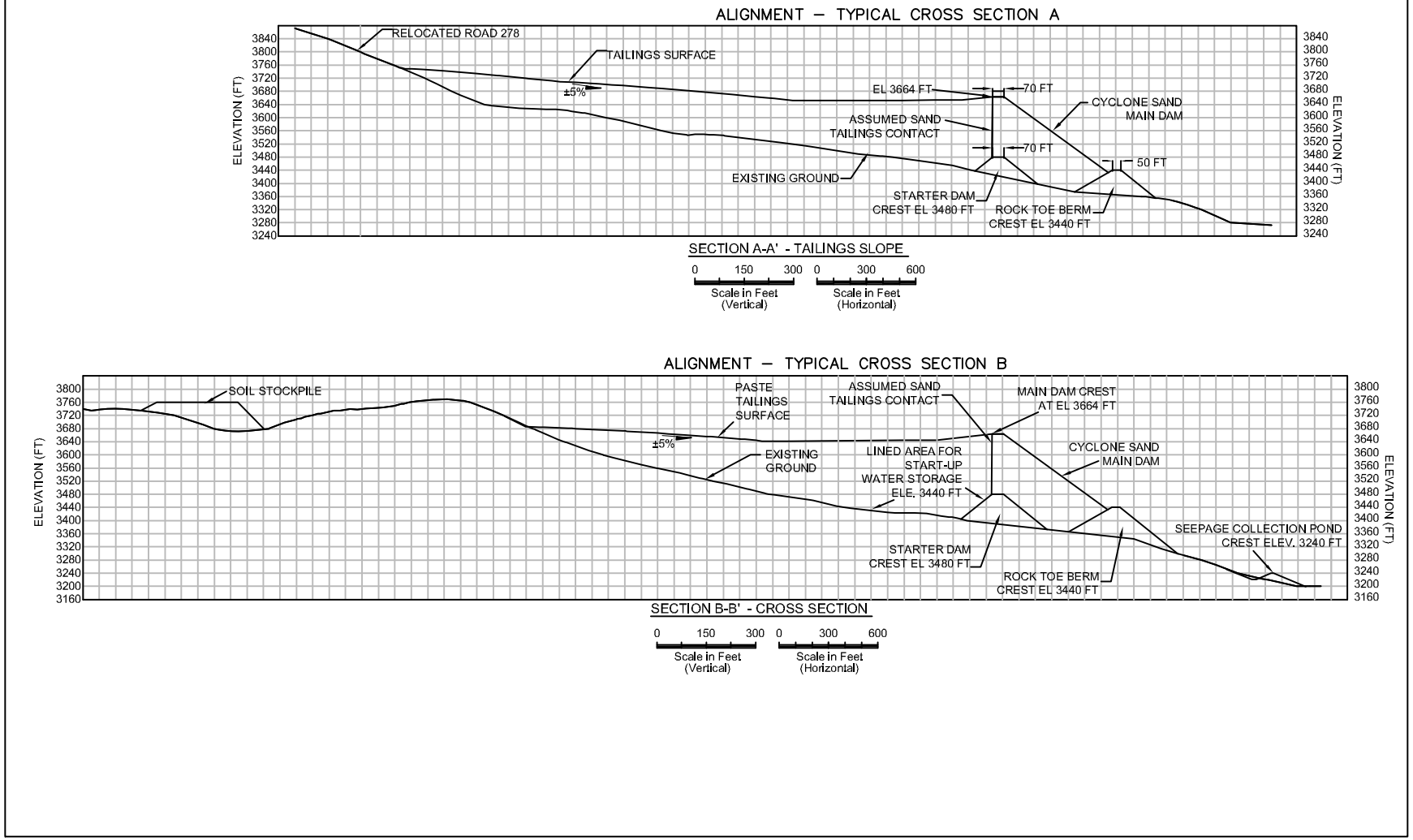


Figure 27. Poorman Tailings Impoundment Cross Sections

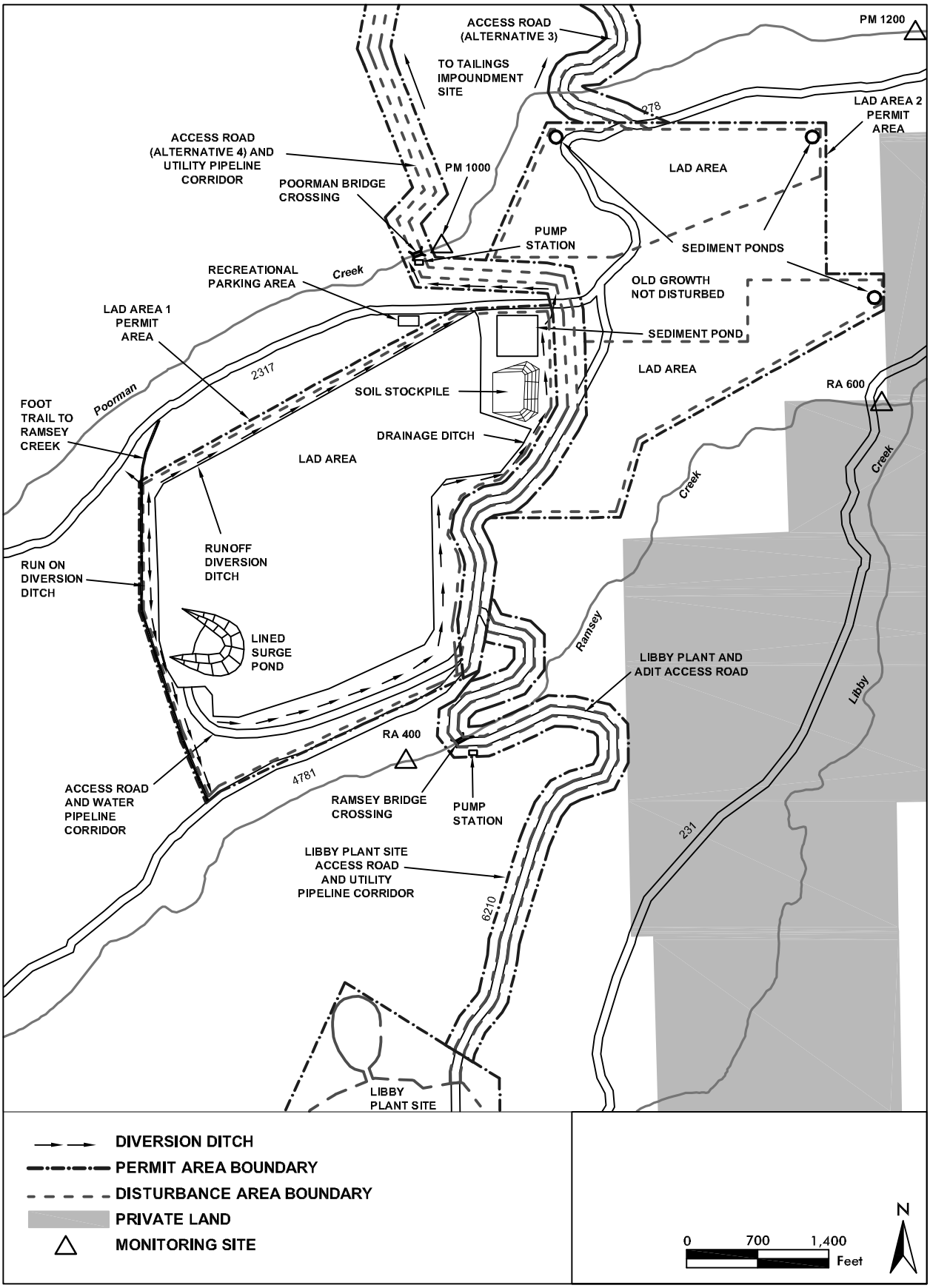


Figure 28. LAD Areas 1 and 2, Alternatives 3 and 4

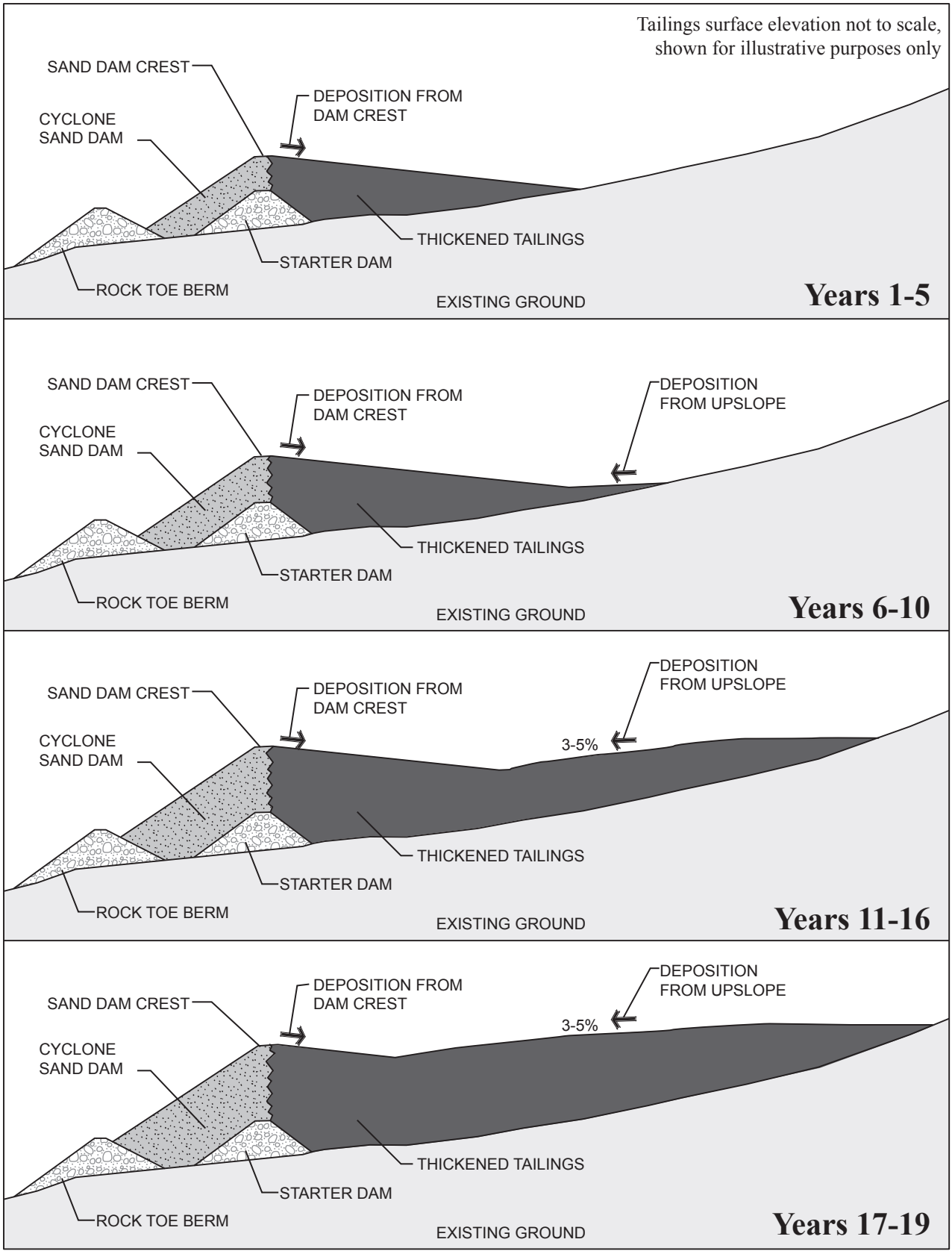


Figure 29. Tailings Deposition over Time, Alternative 3

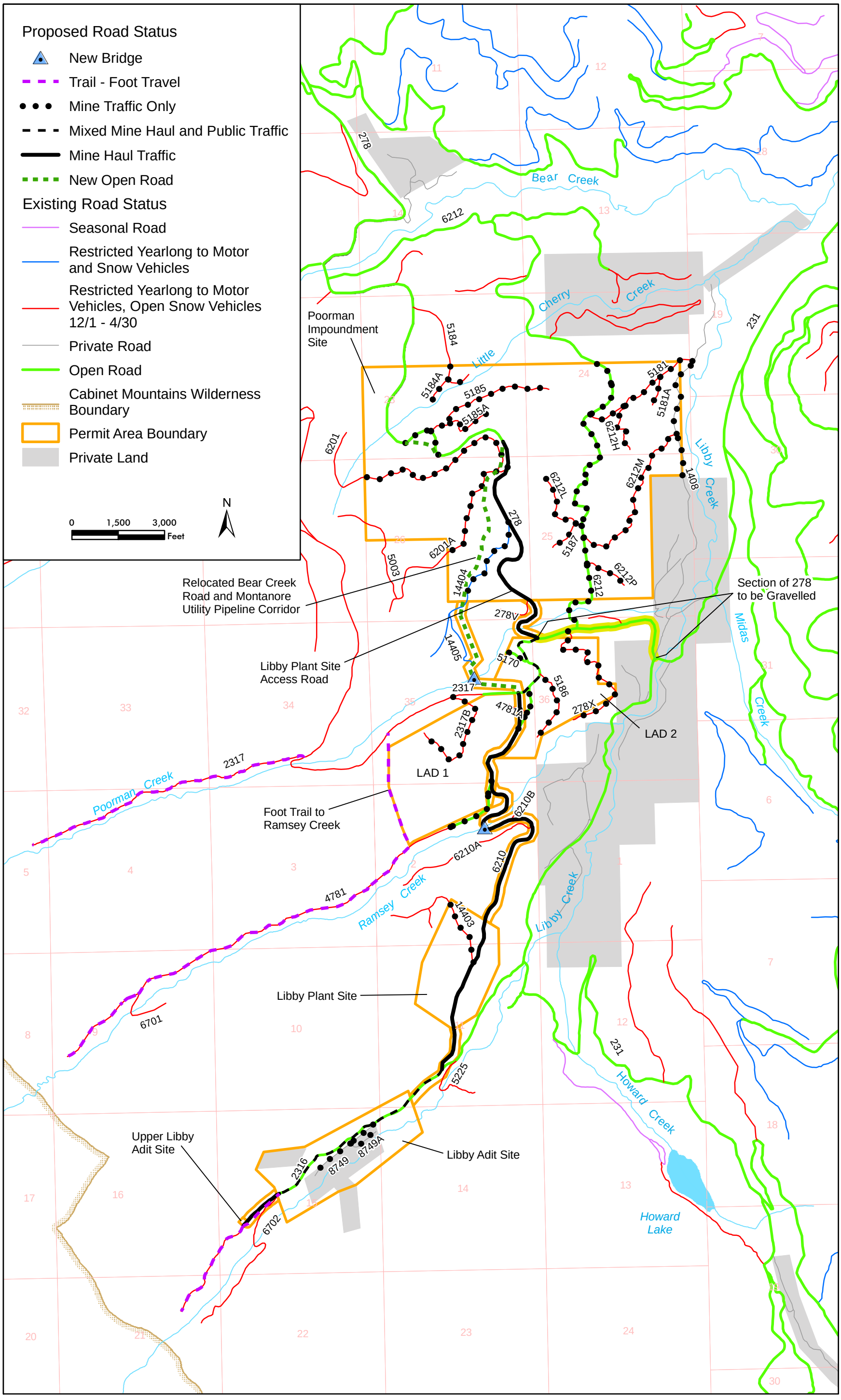


Figure 30. Roads Proposed for Use in Alternative 3

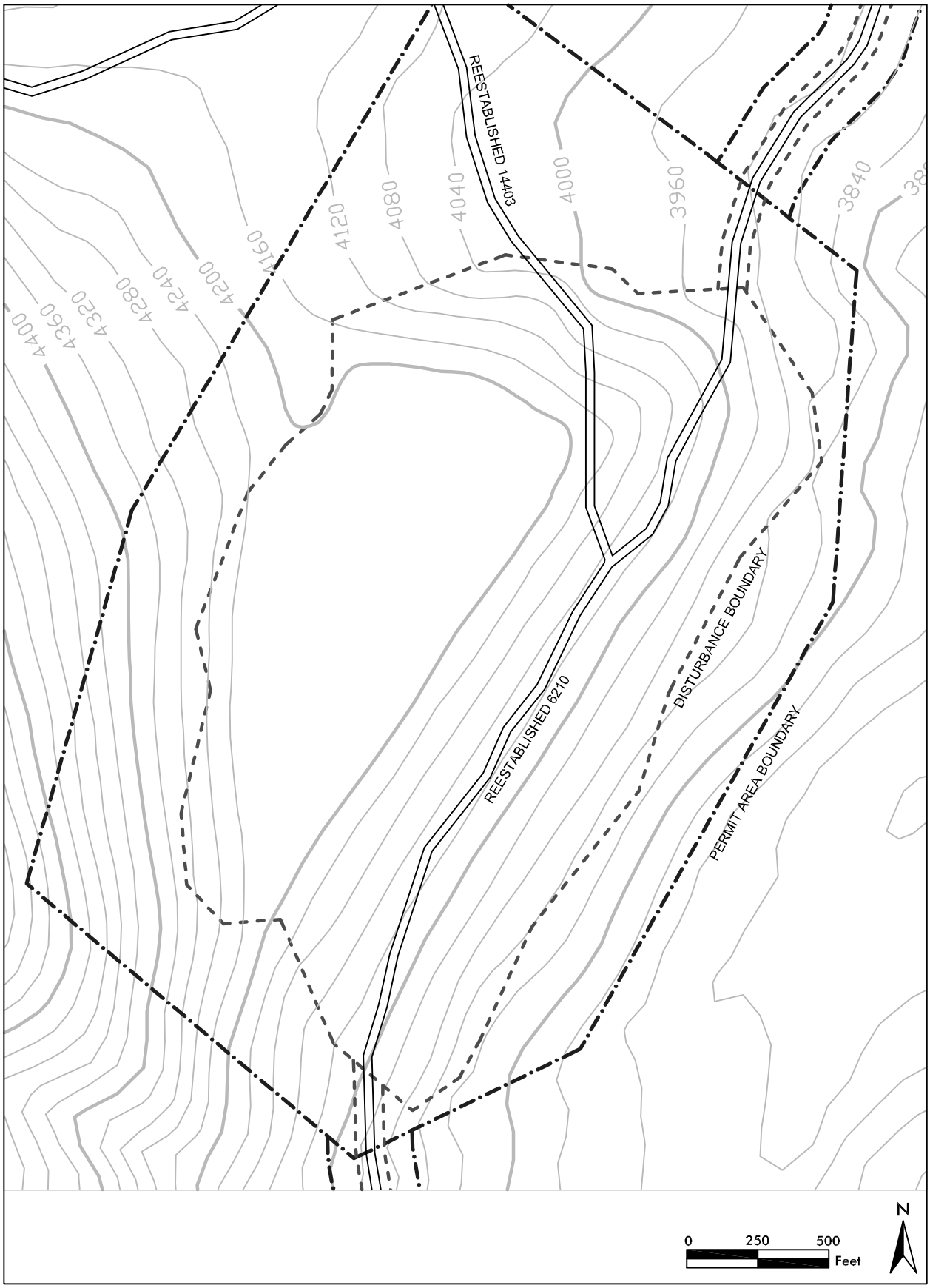


Figure 31. Post-mining Topography, Libby Plant Site, Alternatives 3 and 4

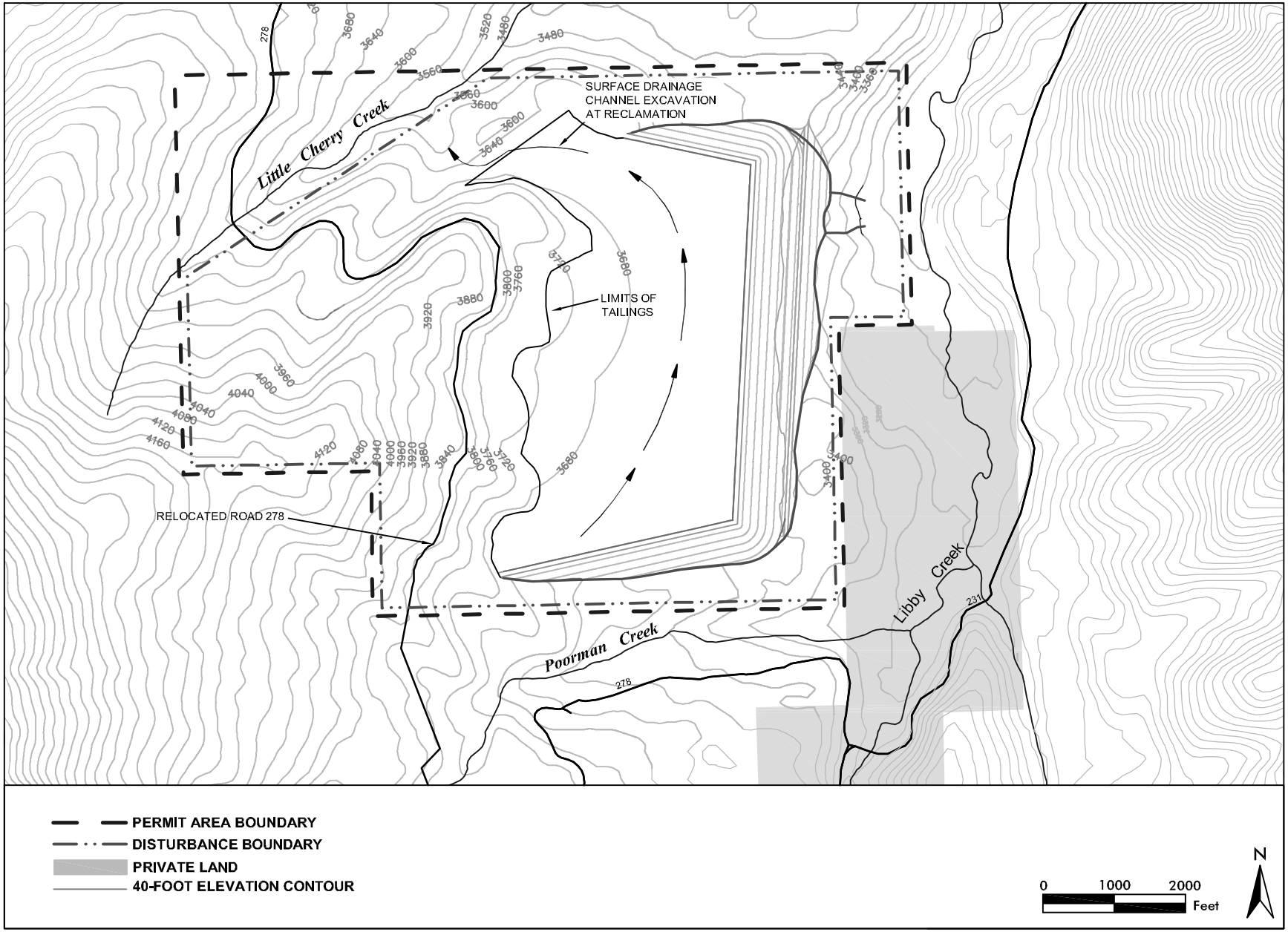


Figure 32. Post-mining Topography, Poorman Tailings Impoundment Site, Alternative 3

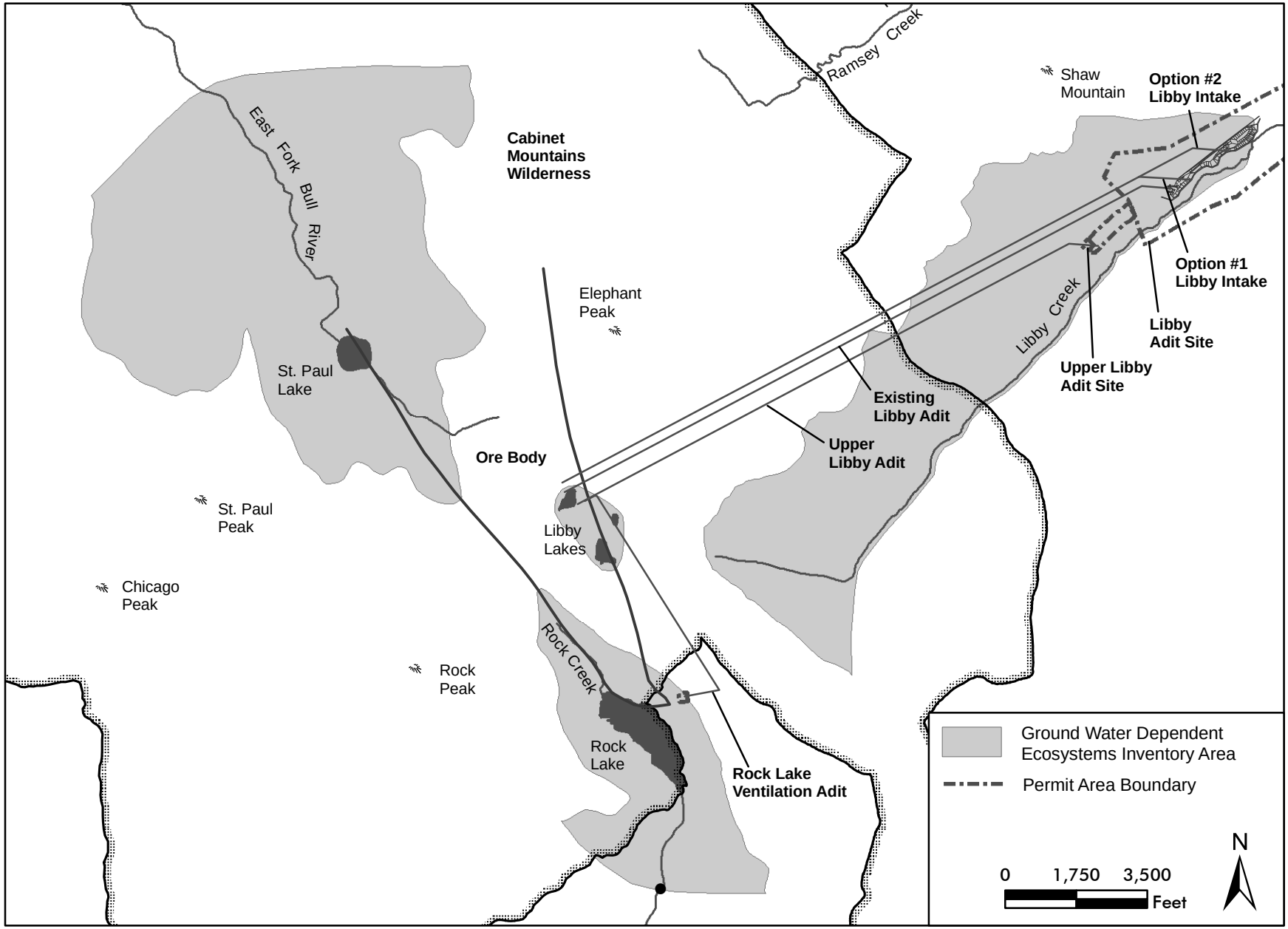


Figure 33. Gound Water Dependent Ecosystems Inventory Areas, Alternatives 3 and 4

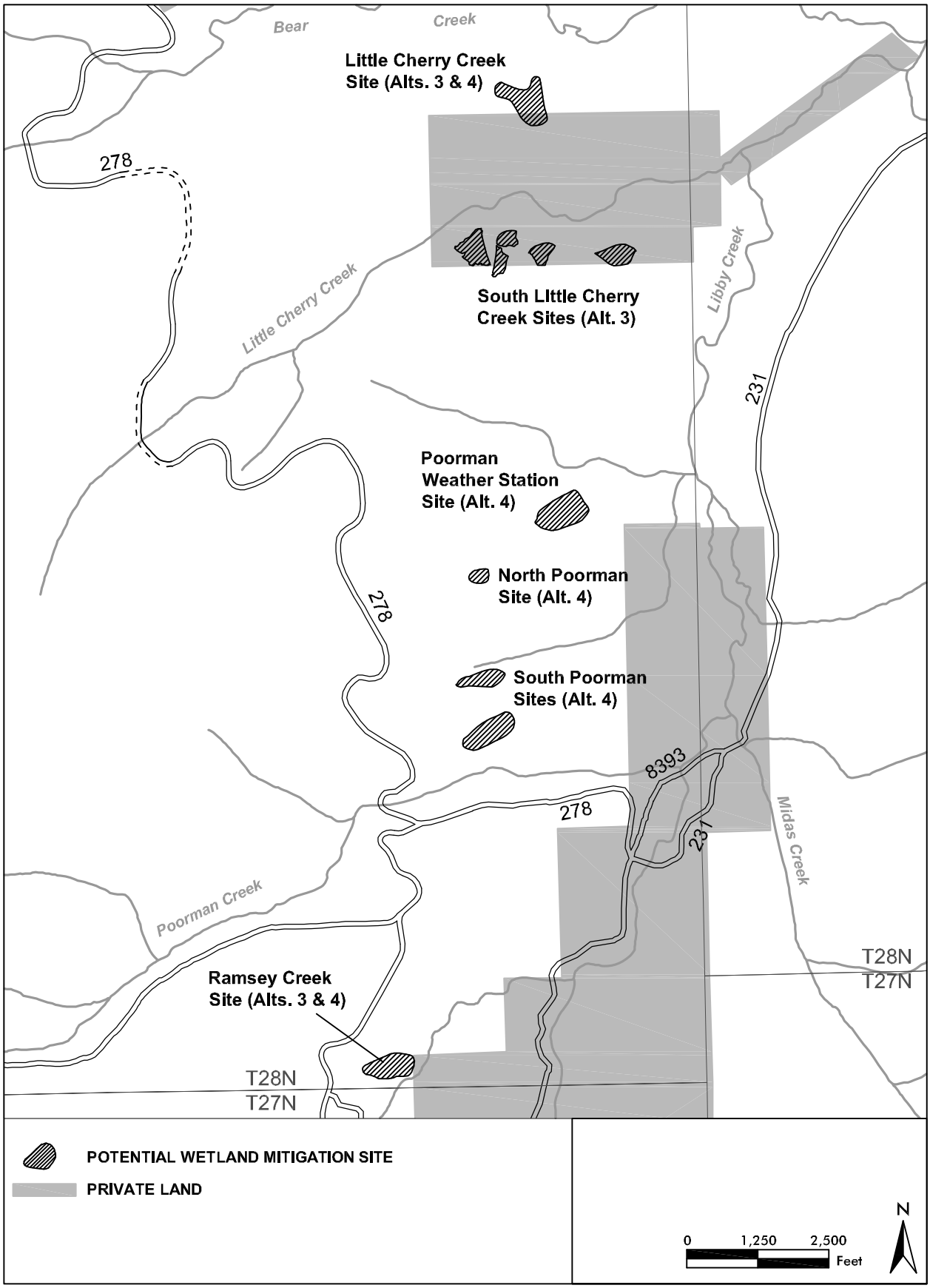


Figure 34. Potential Wetland Mitigation Sites, Alternatives 3 and 4

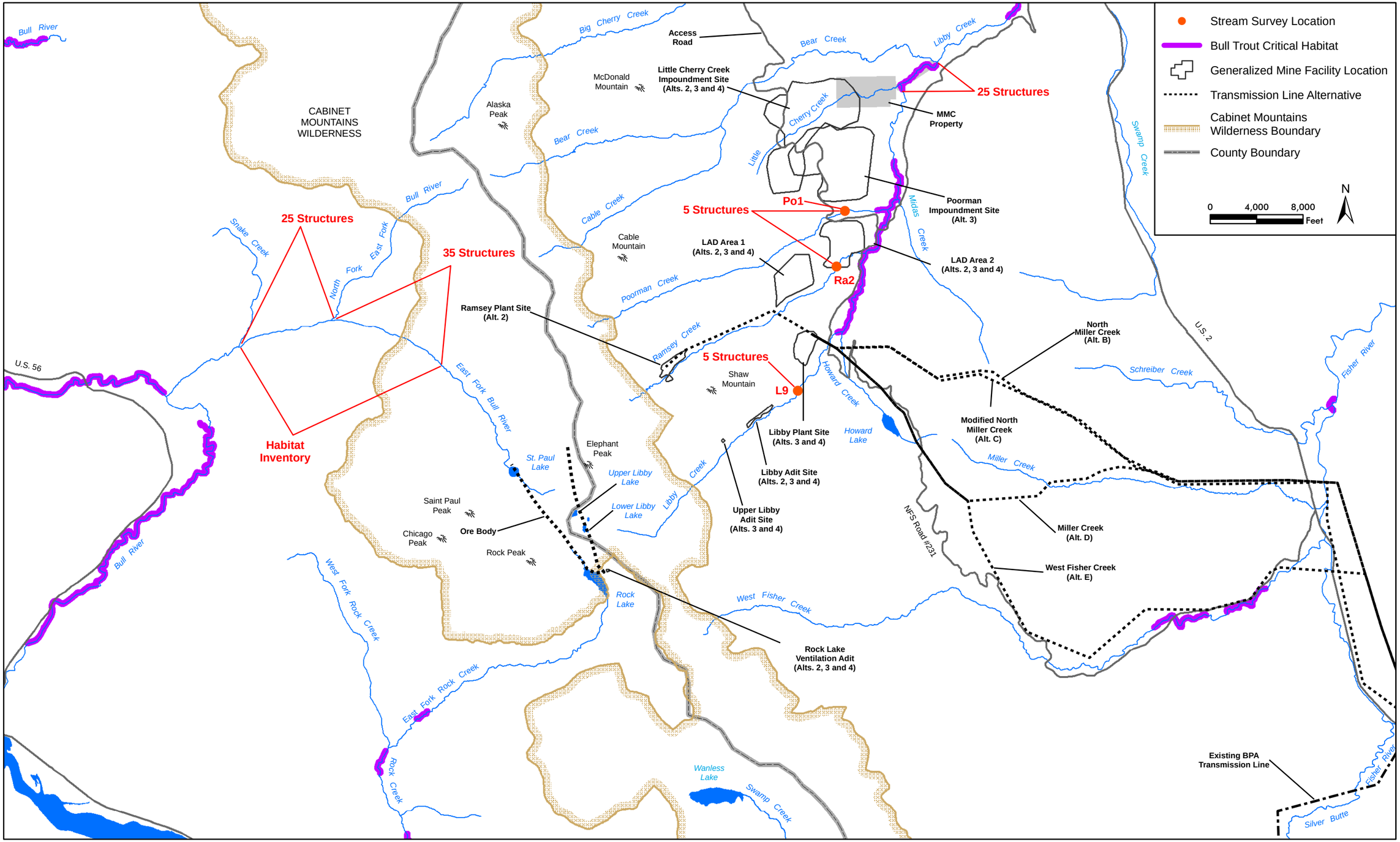


Figure 35. Proposed Fisheries Mitigation, Alternatives 3 and 4

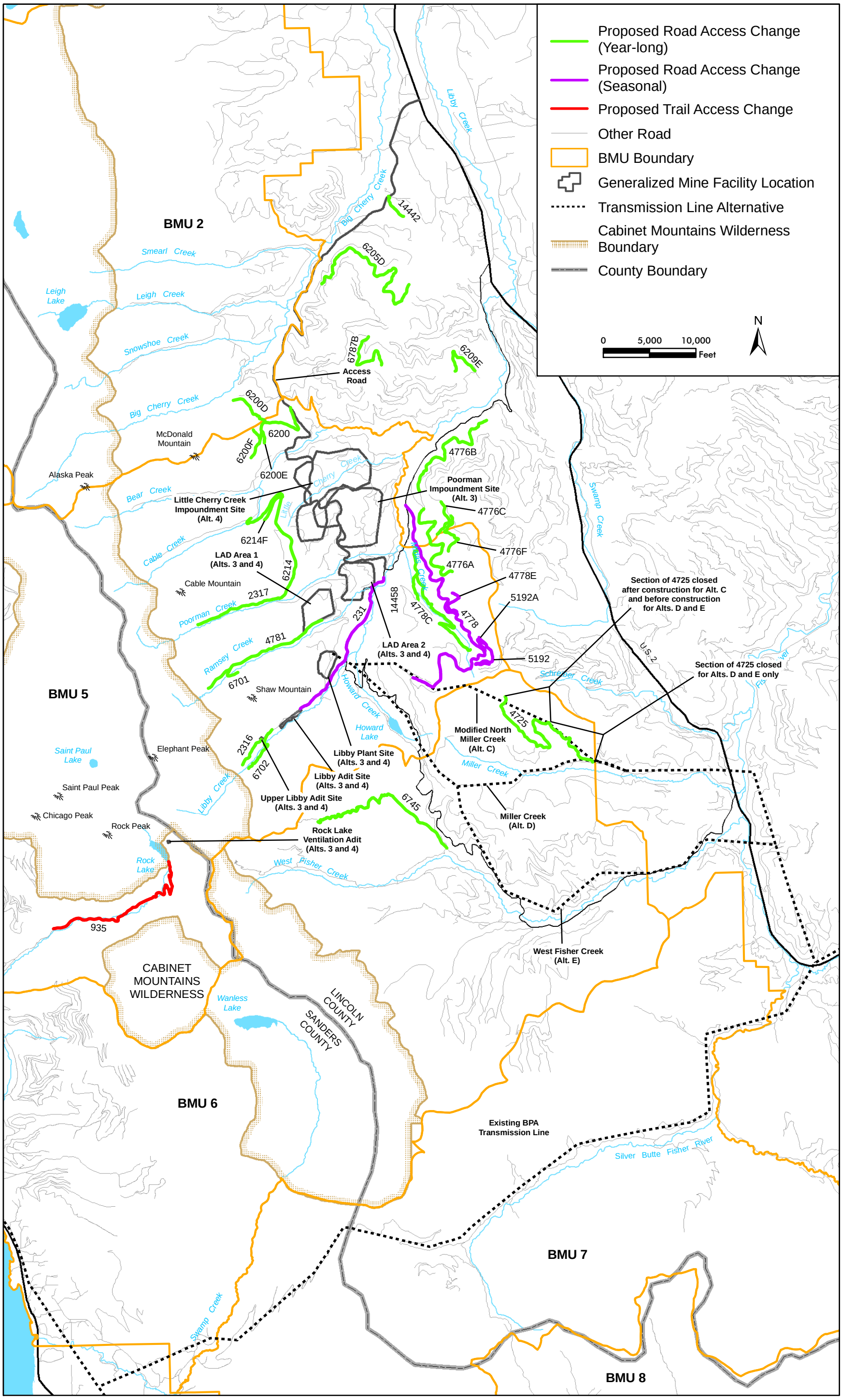


Figure 36. KNF Proposed Road and Trail Access Changes for Wildlife Mitigation, Alternatives 3, 4, C, D, and E

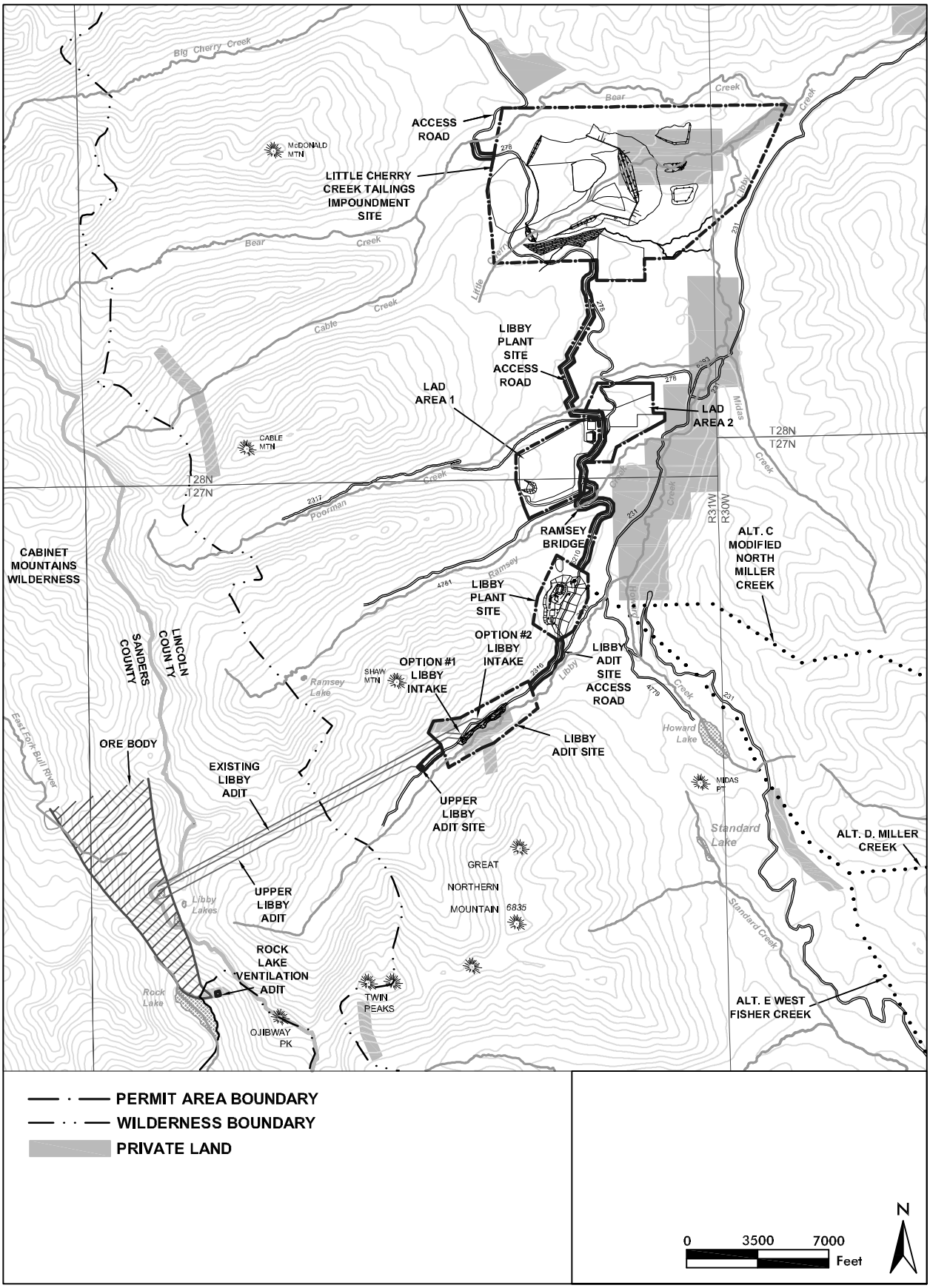


Figure 37. Mine Facilities and Permit Areas, Alternative 4

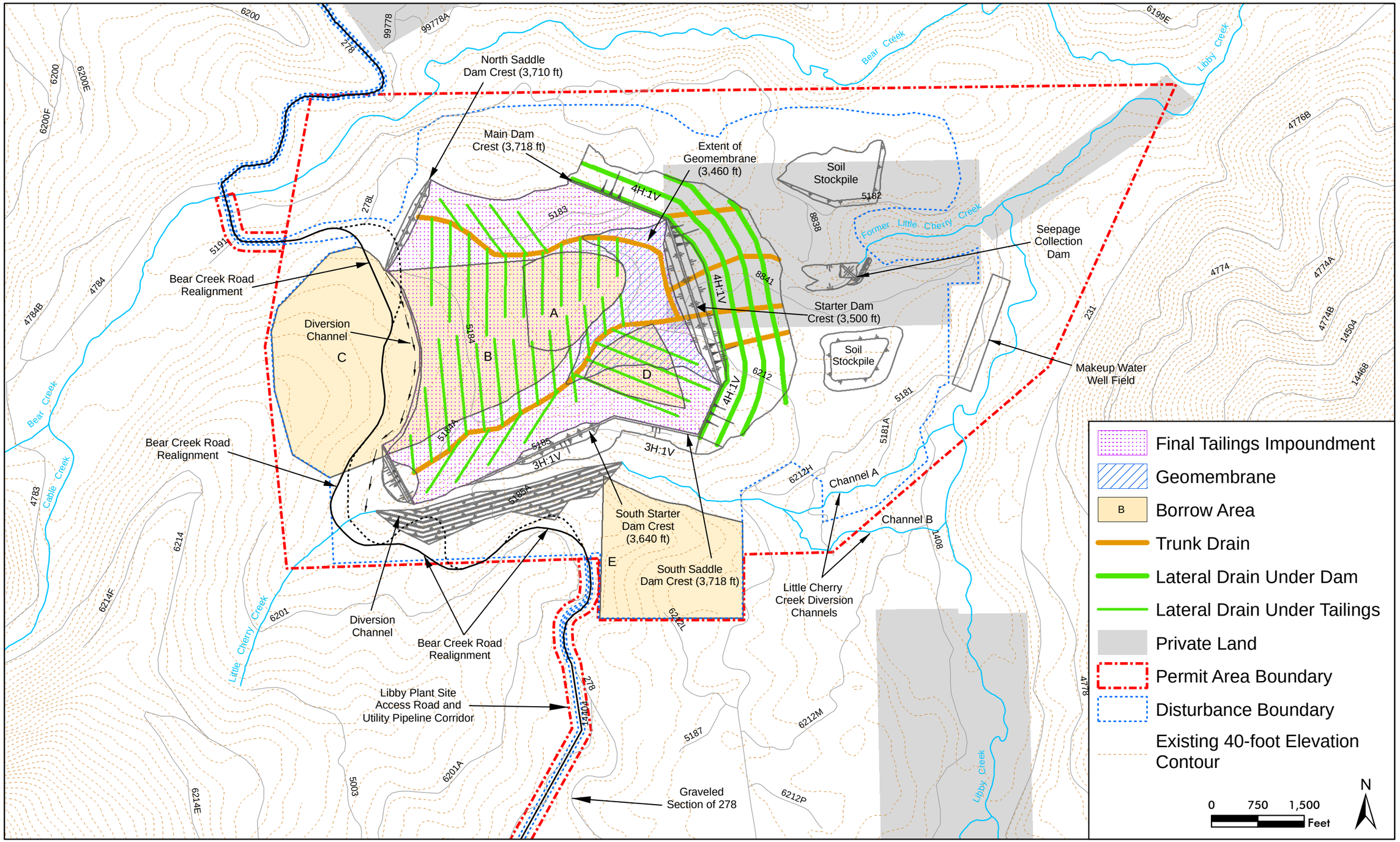


Figure 38. Little Cherry Creek Tailings Impoundment Site, Alternative 4

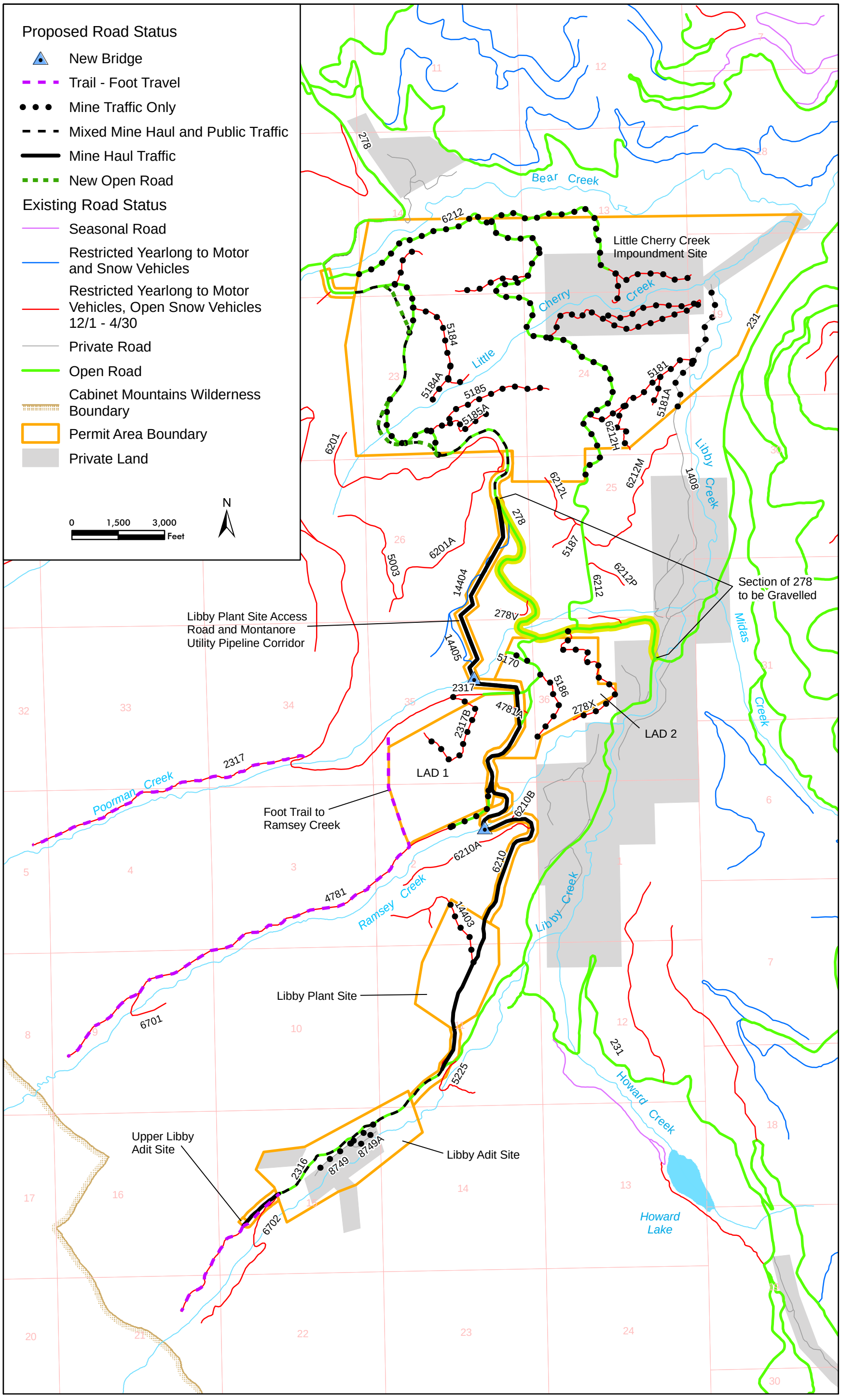


Figure 39. Roads Proposed for Use in Alternative 4

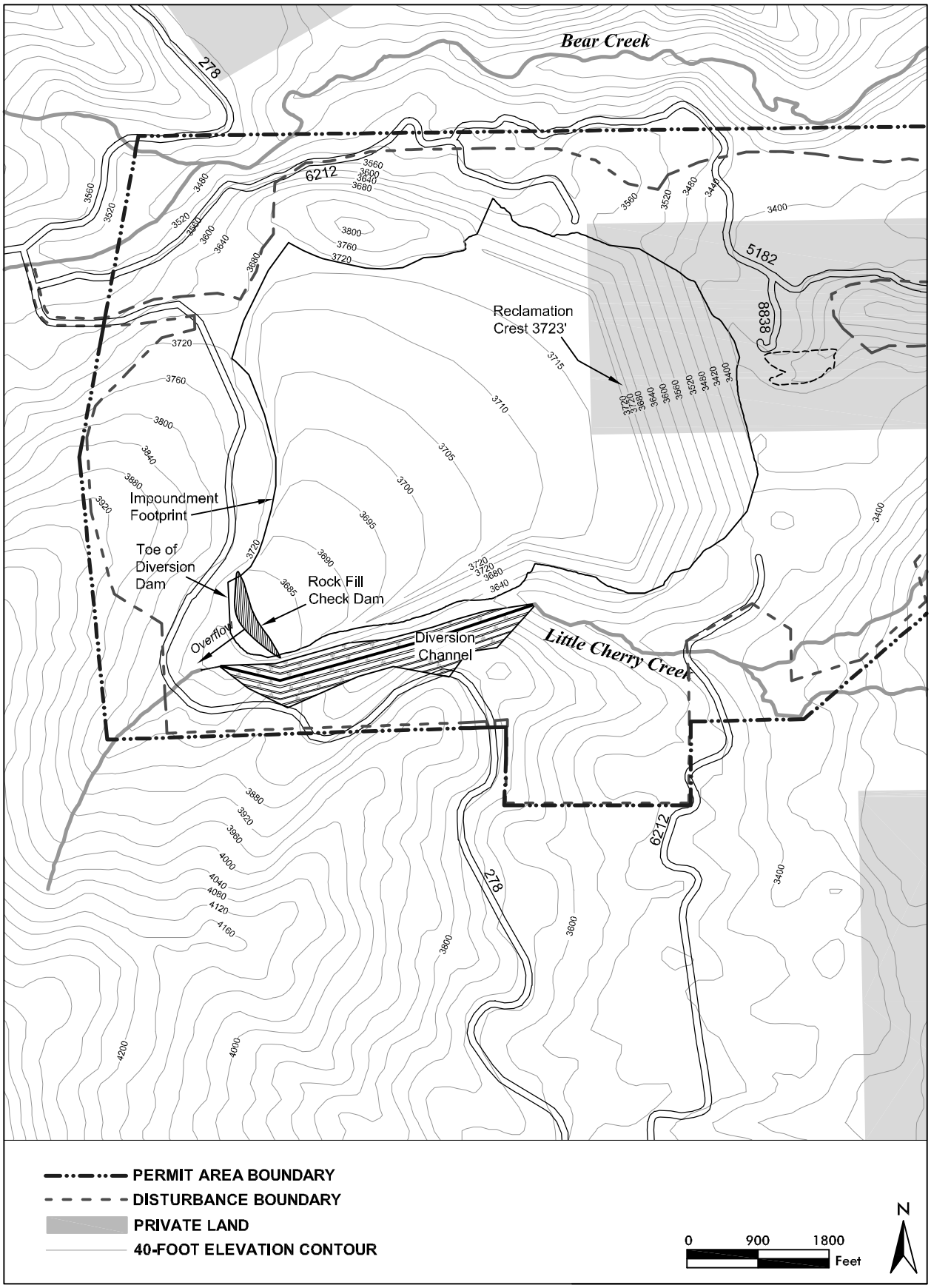


Figure 40. Post-mining Topography, Little Cherry Creek Tailings Impoundment Site, Alternative 4

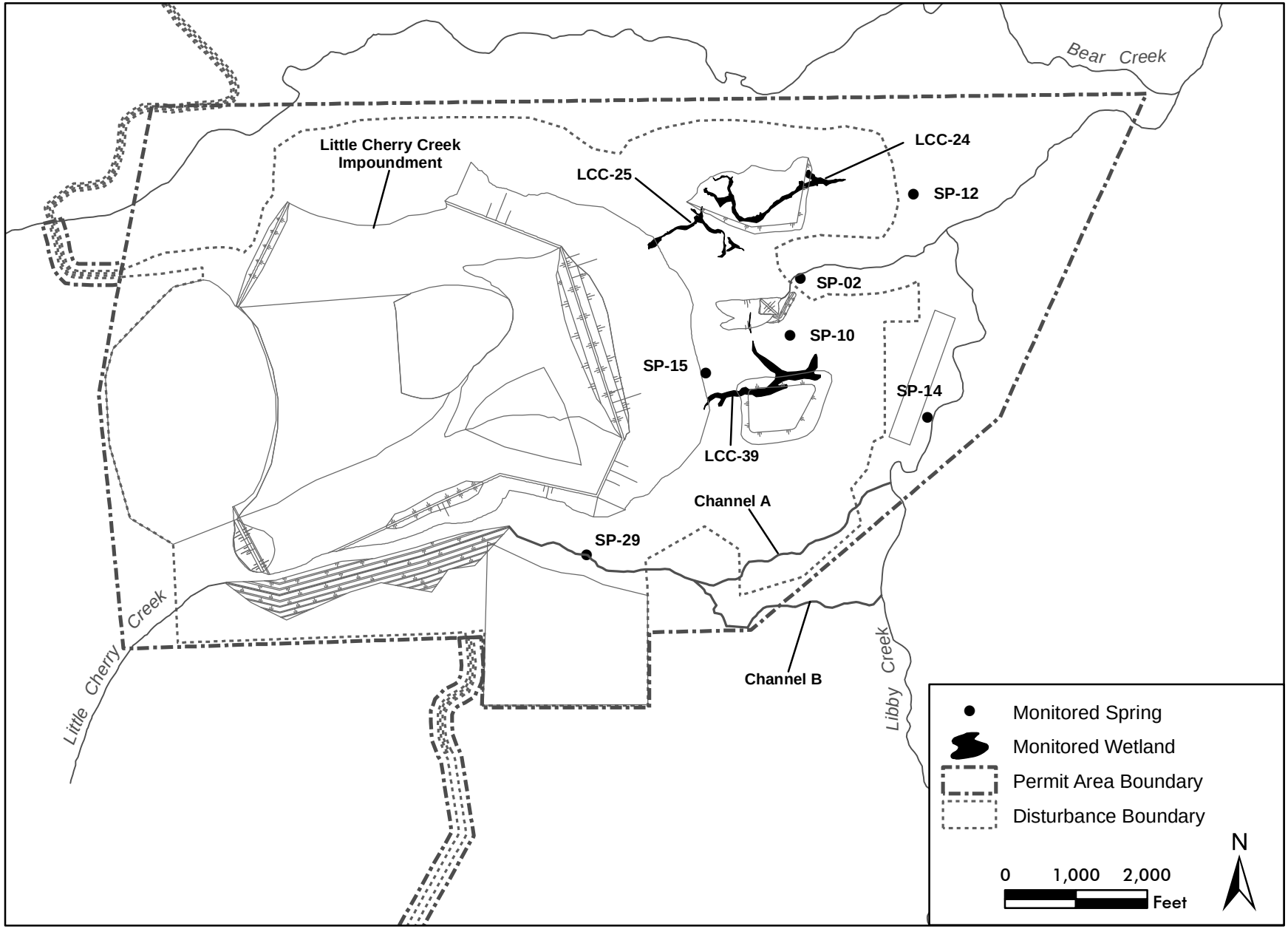


Figure 41. Spring and Wetland Monitoring Locations in the Impoundment Area, Alternative 4

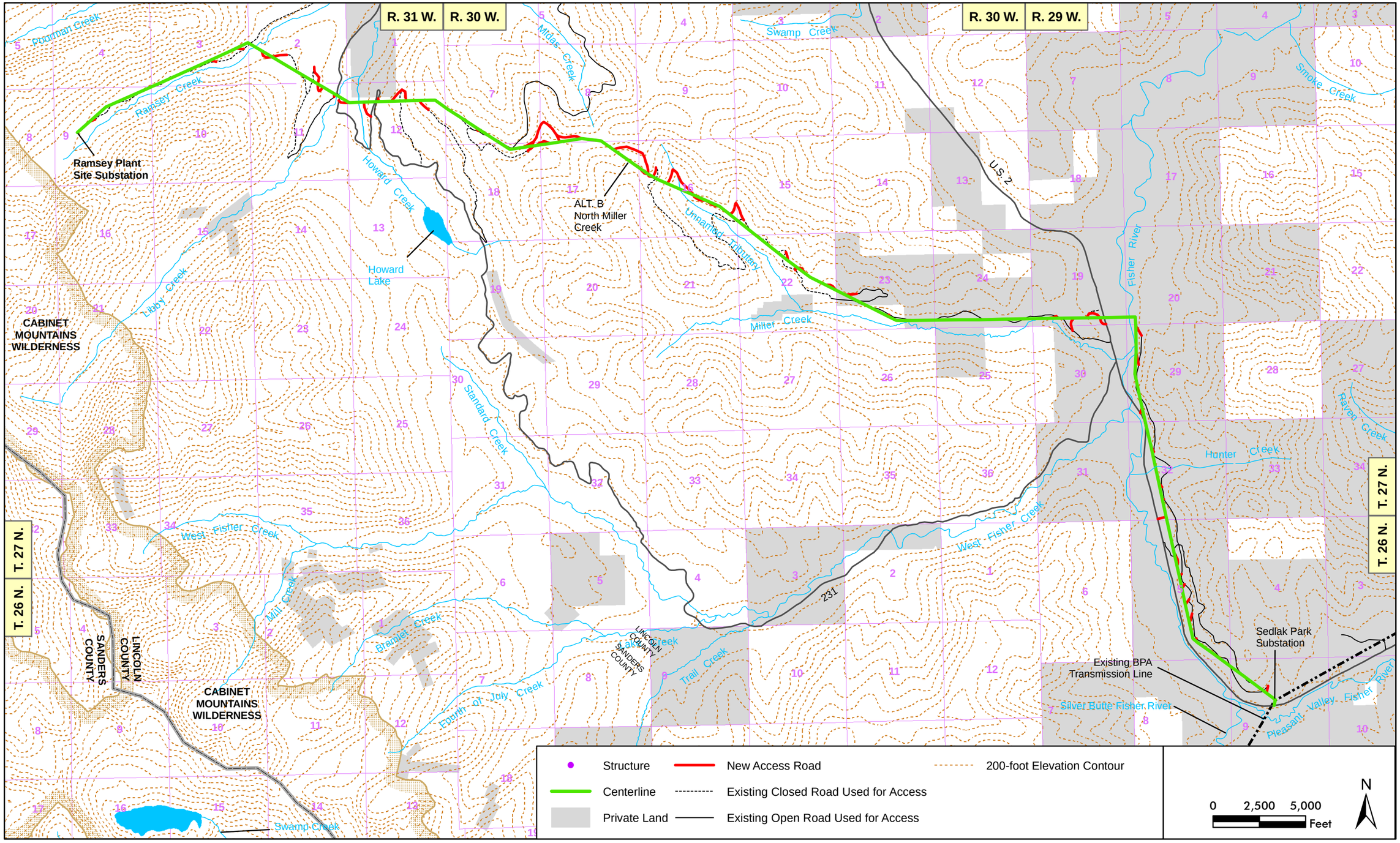


Figure 42. North Miller Creek Alignment, Structures, and Access Roads, Alternative B

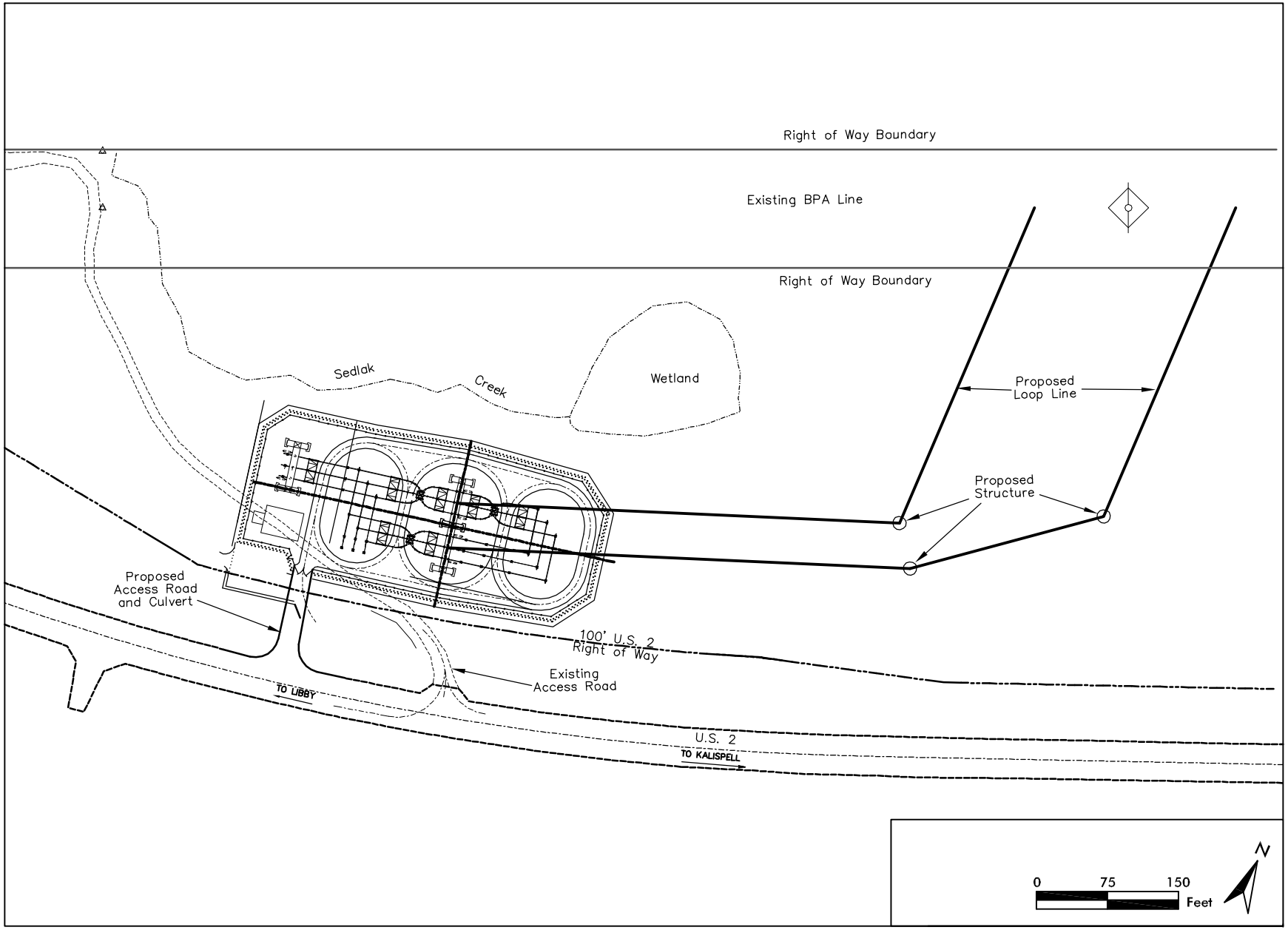
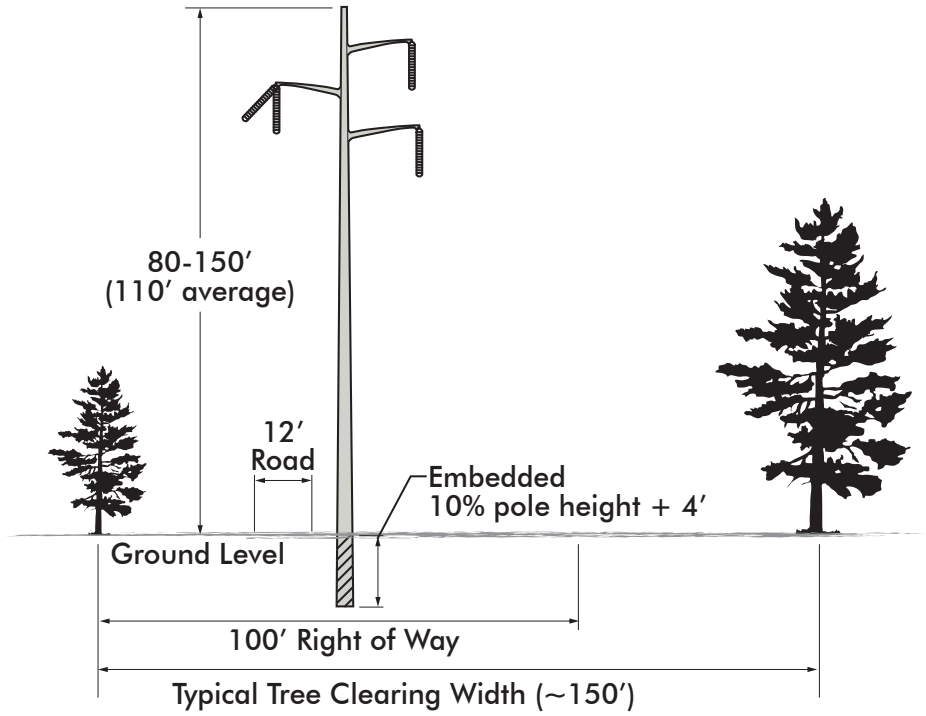
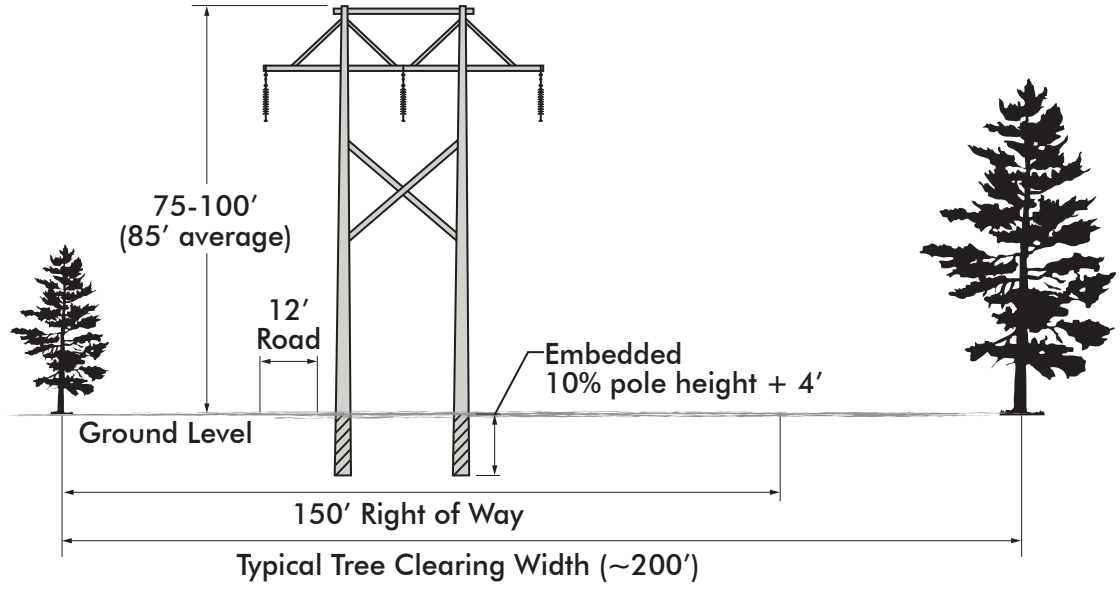


Figure 43. Sedlak Park Substation

Monopole Structure



H-Frame Structure



Note: most shrubs would not require clearing on either structure type.

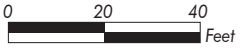


Figure 44. Transmission Line Right-of-Way and Clearing Requirements

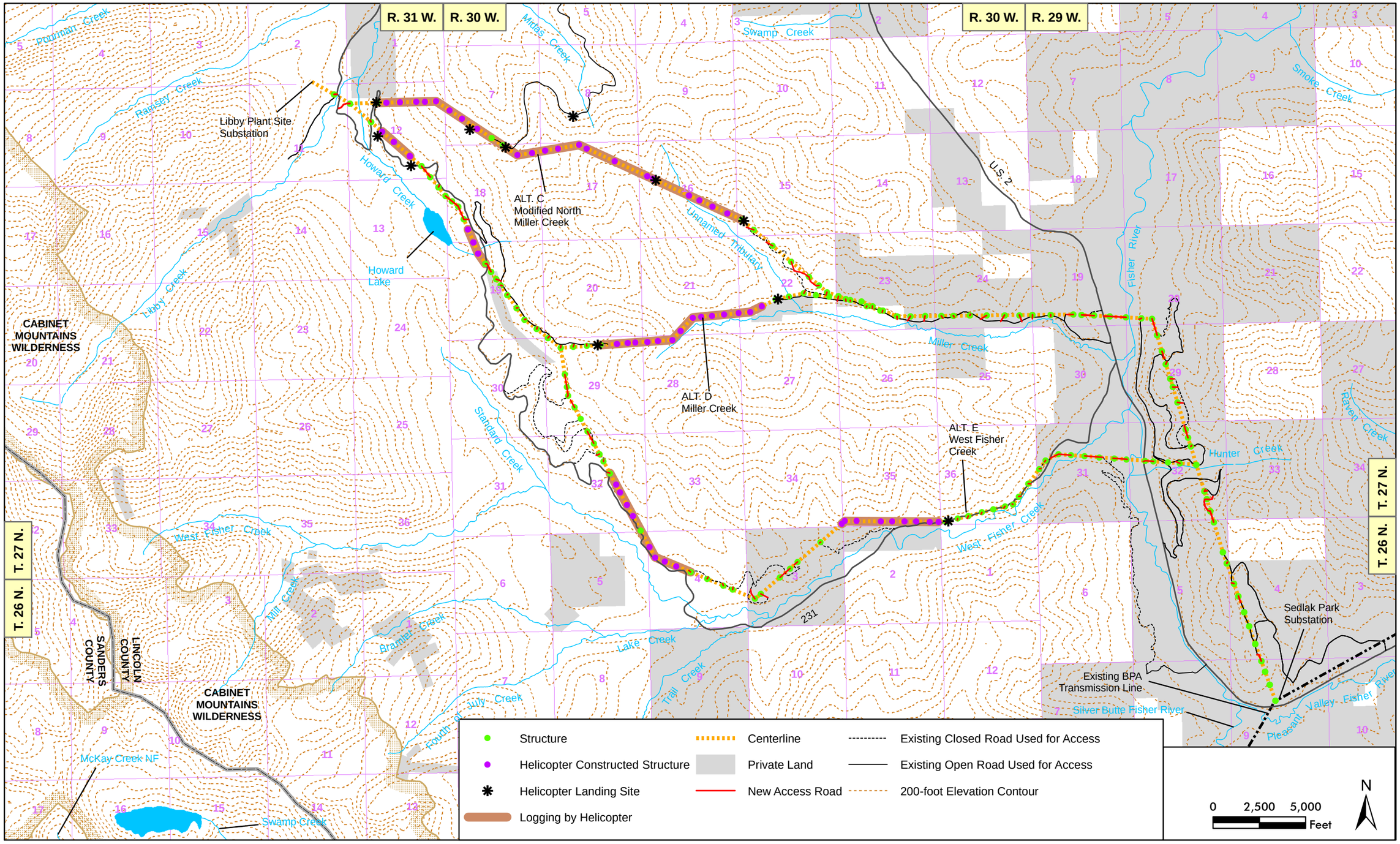


Figure 45. Transmission Line Alignment, Structures, and Access Roads, Alternatives C-E

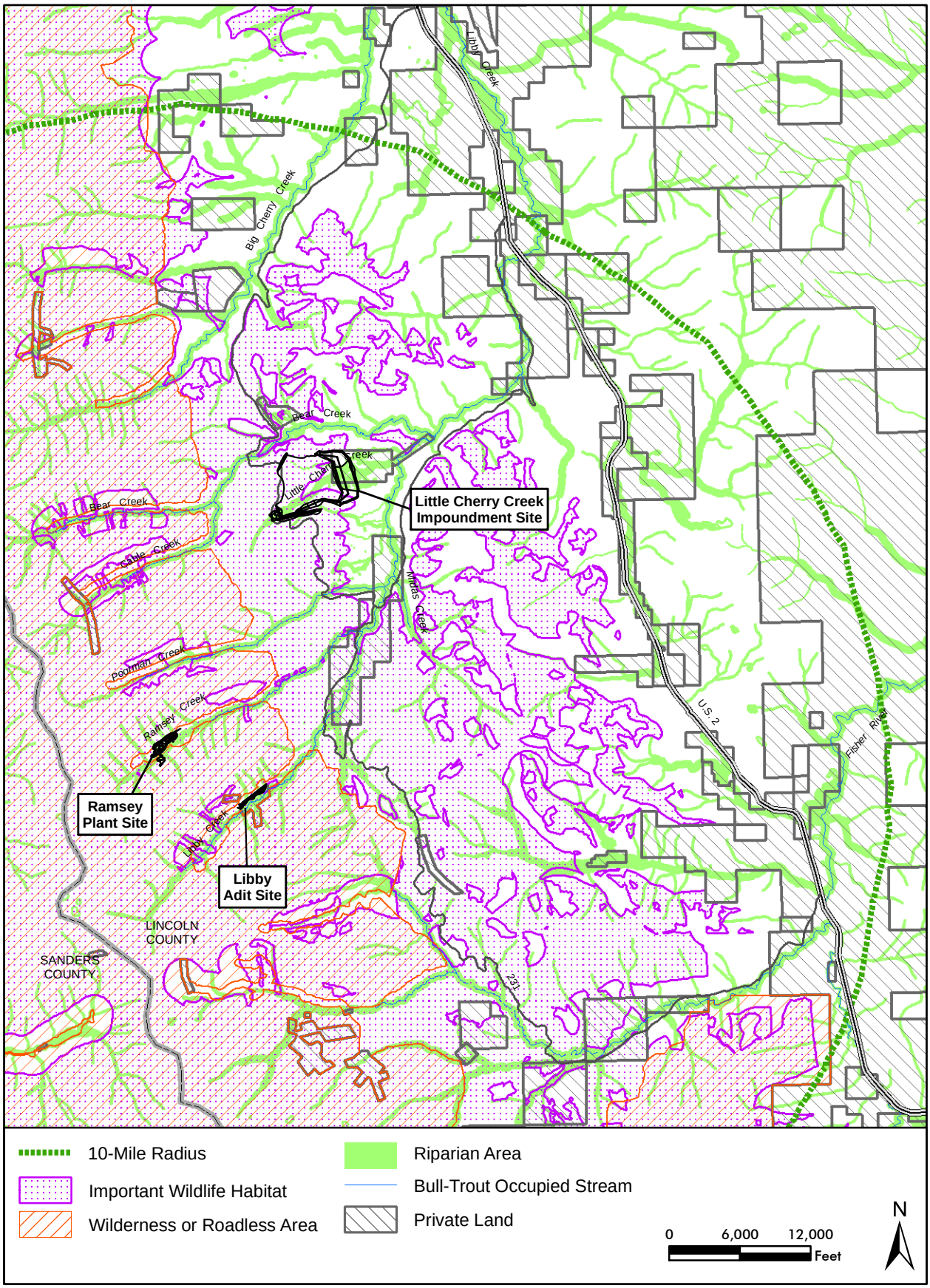


Figure 46. Key Resources Evaluated in the 2005-2007 Alternatives Analysis

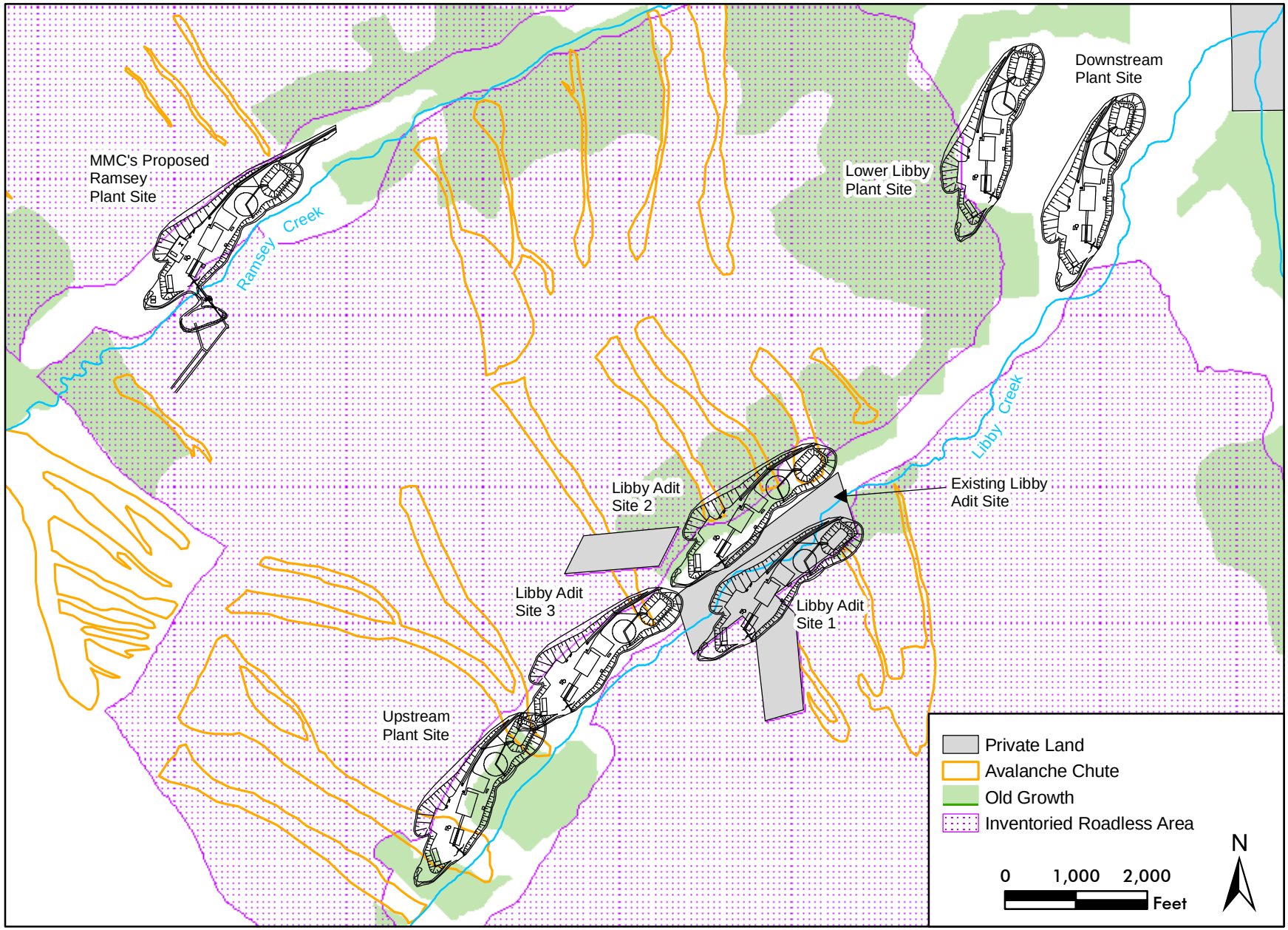


Figure 47. Plant Sites Evaluated in Upper Libby Creek for this EIS

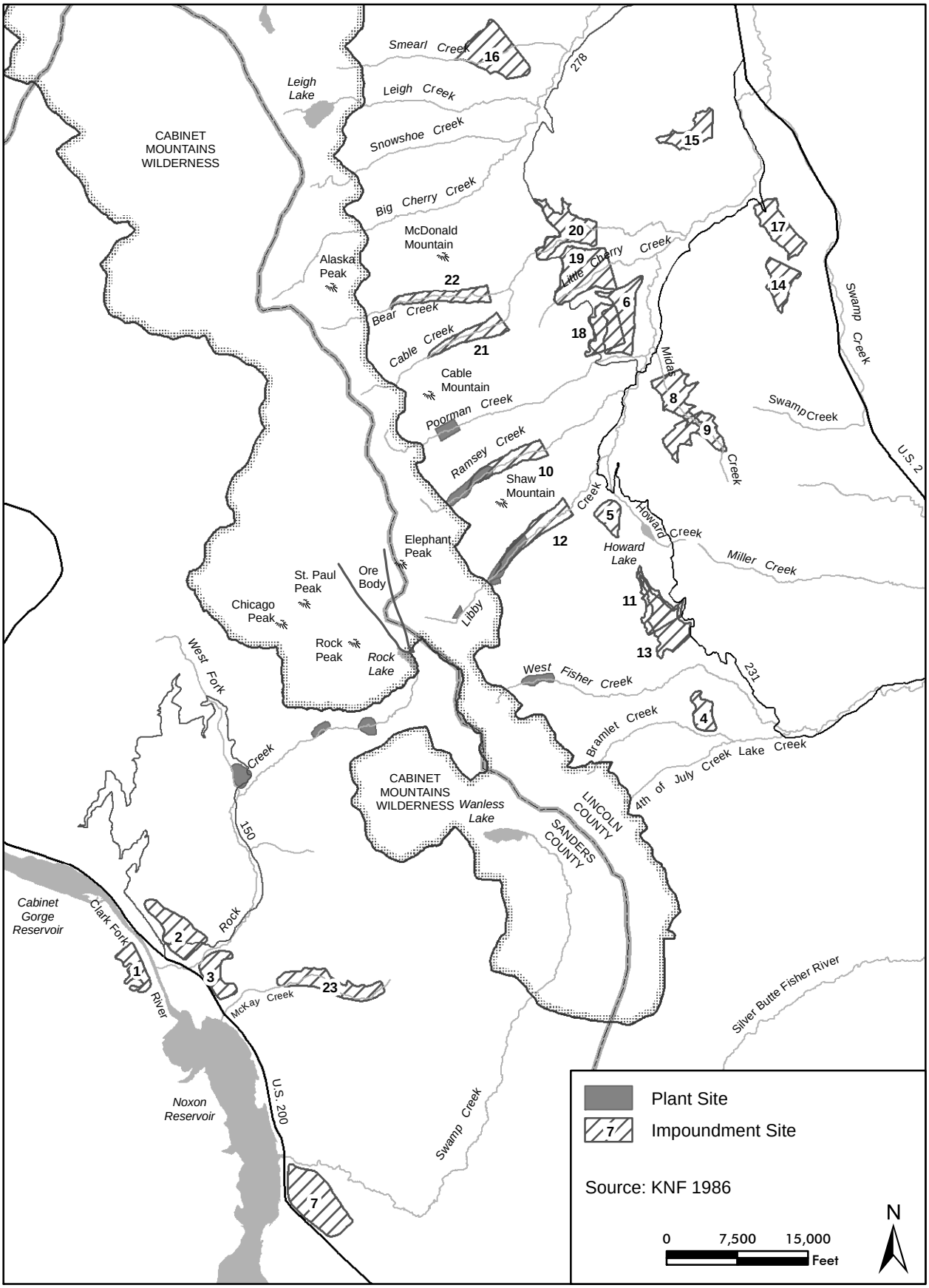


Figure 48. Plant and Impoundment Sites Evaluated in the Initial Screening

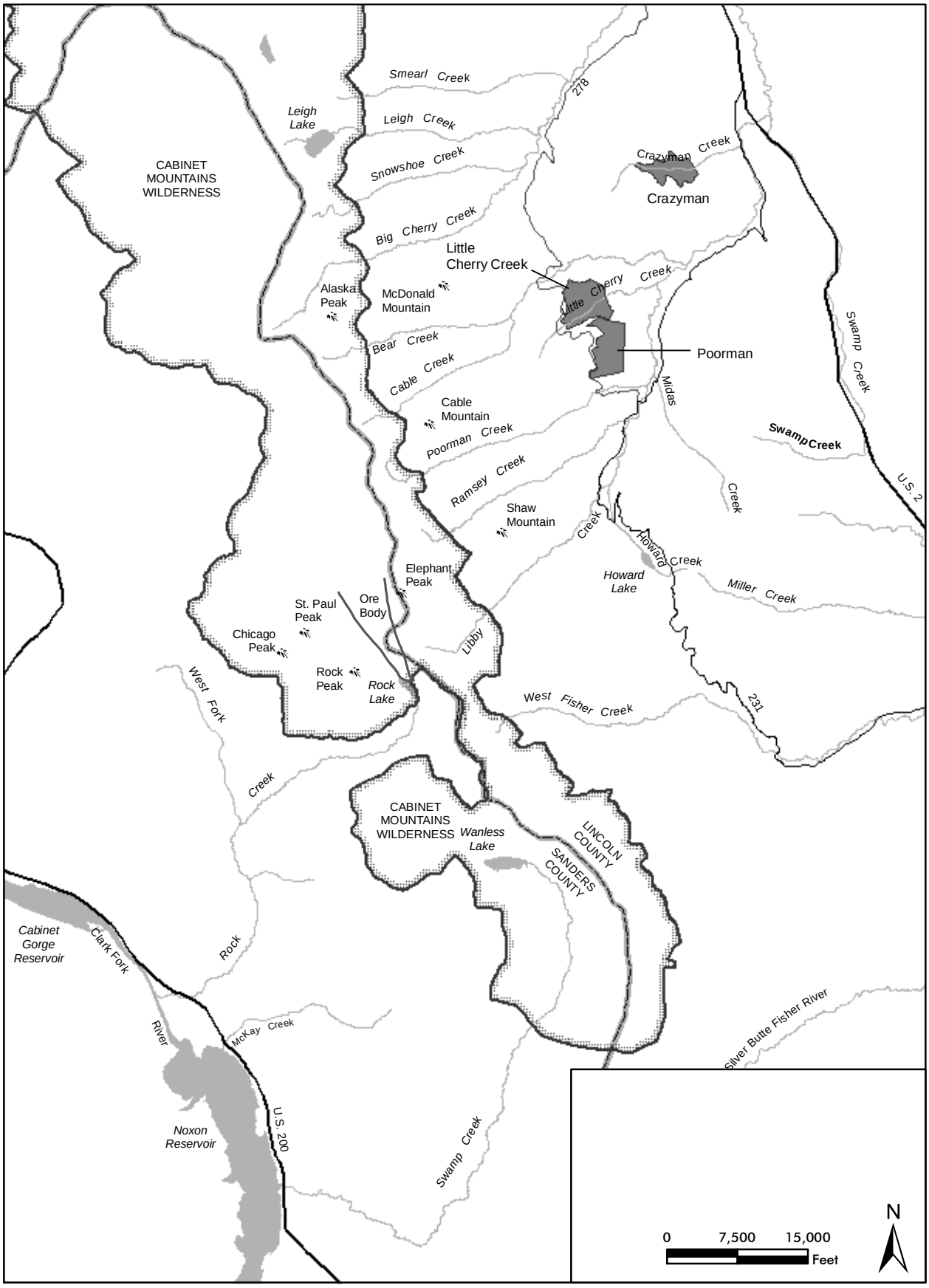


Figure 49. Tailings Impoundment Sites Evaluated in the Detailed Screening

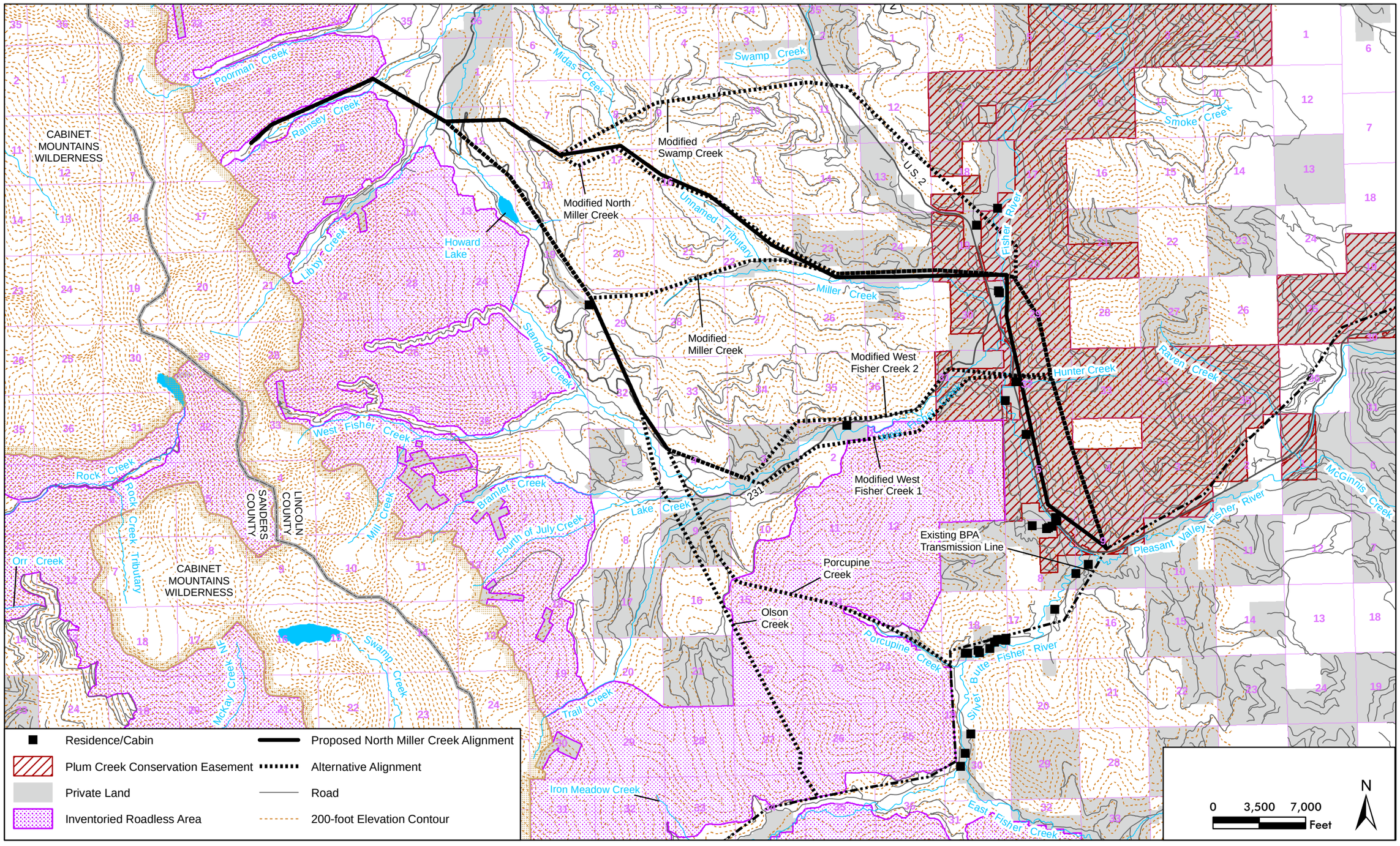


Figure 50. Transmission Line Alignment Alternatives Evaluated for this EIS

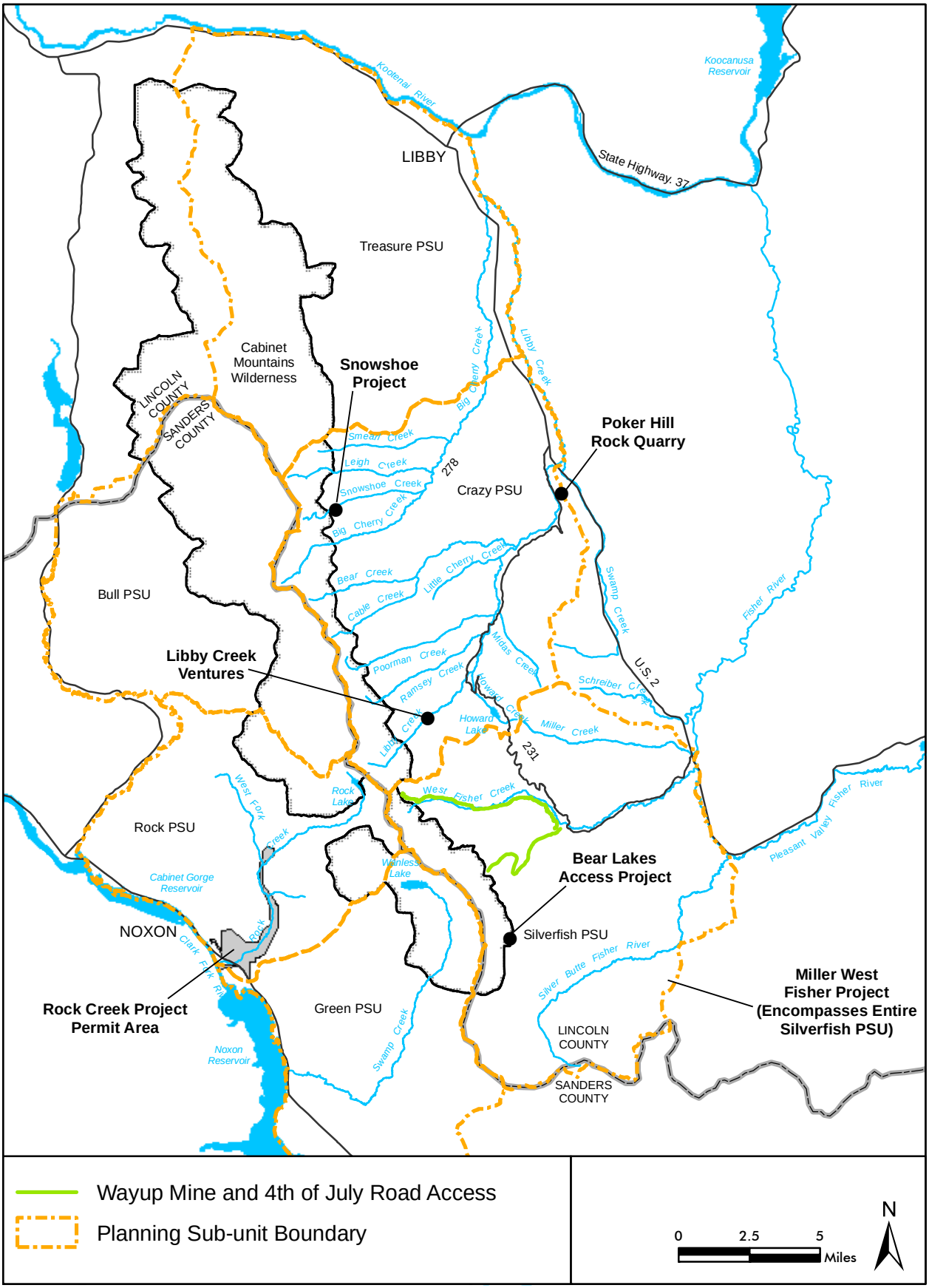


Figure 51. Past, Current and Reasonably Foreseeable Actions for the Proposed Montanore Project

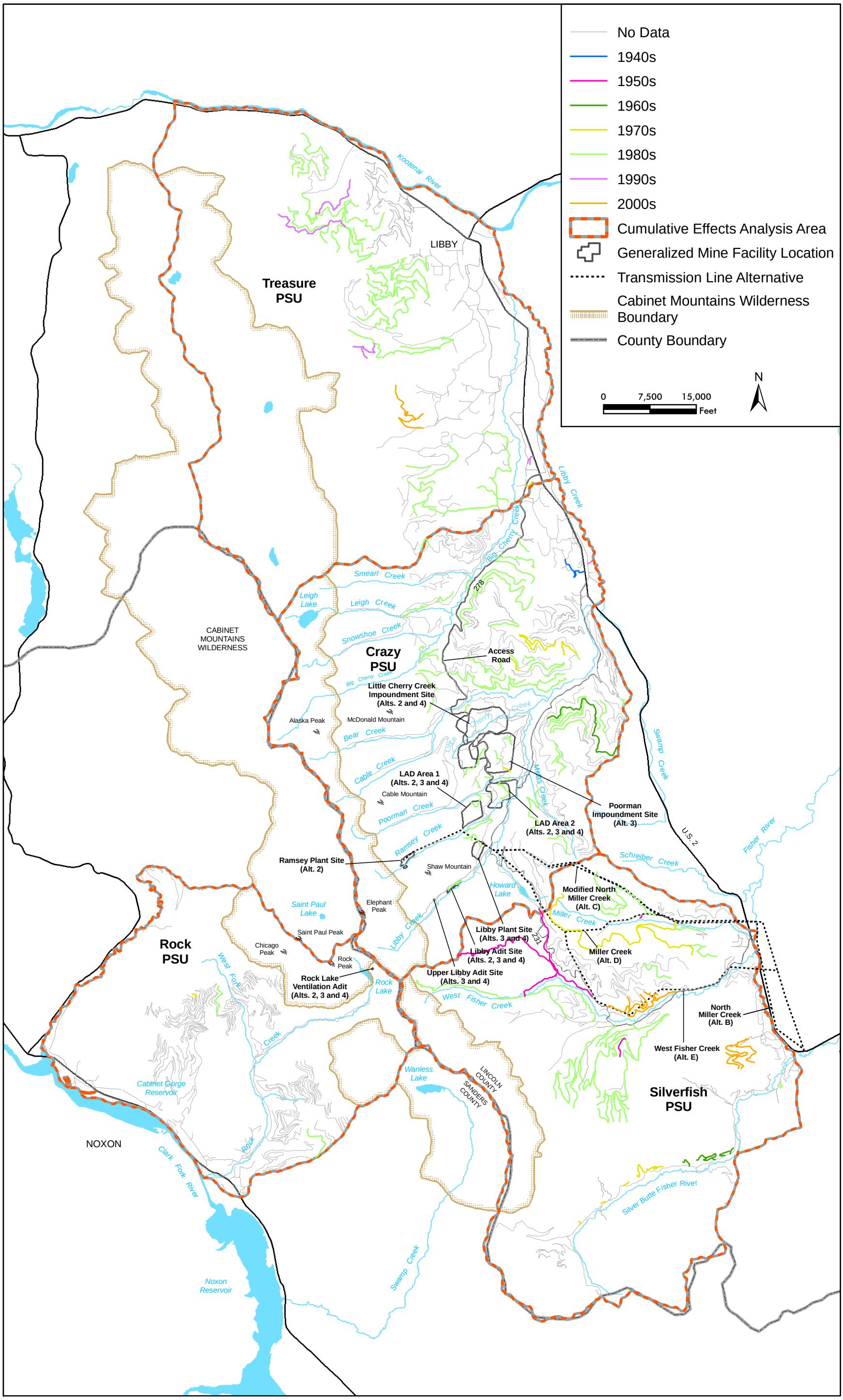


Figure 52. Road Construction by Decade in the Montanore Cumulative Effects Analysis Area

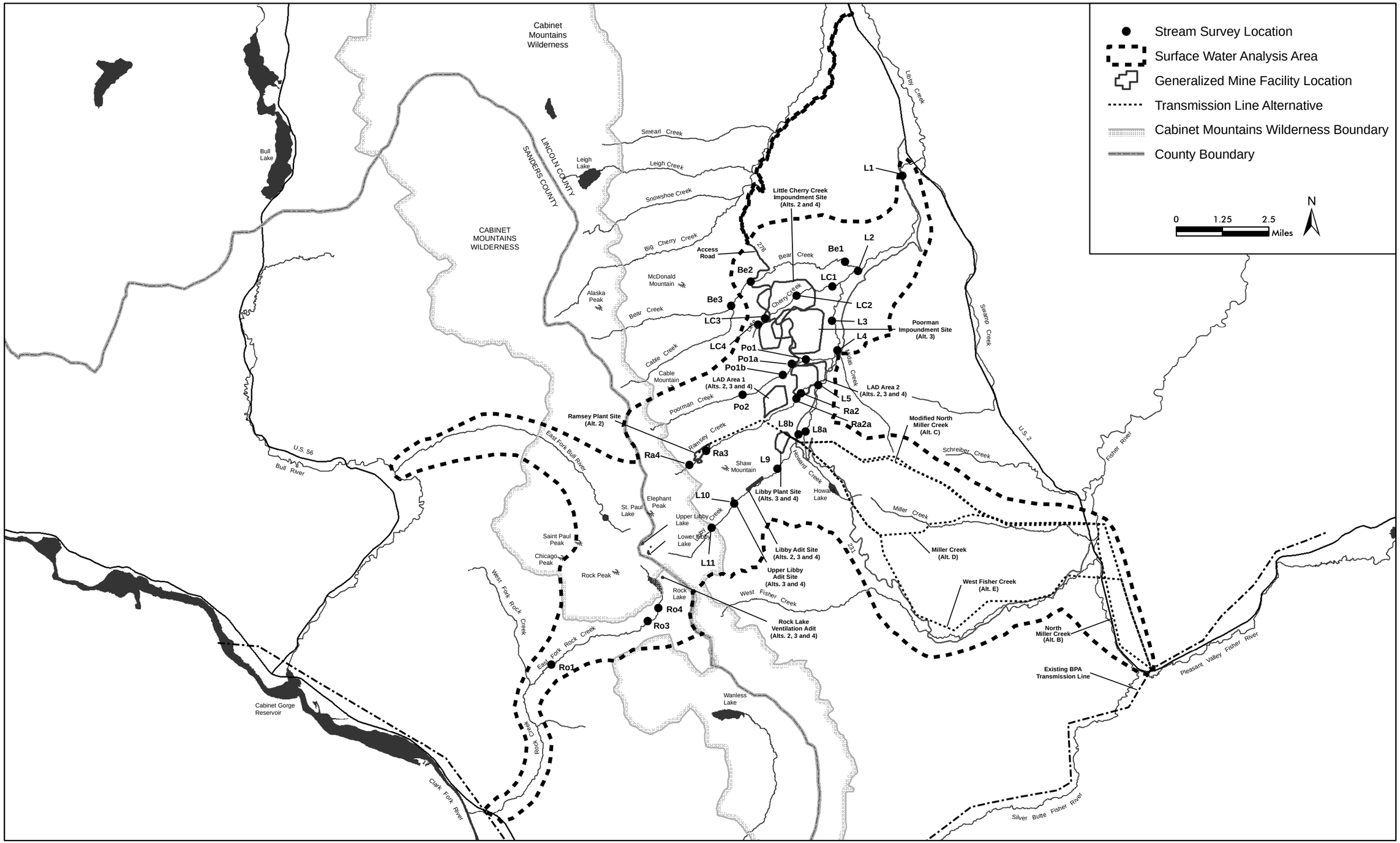


Figure 53. Stream Survey Locations in the Analysis Area

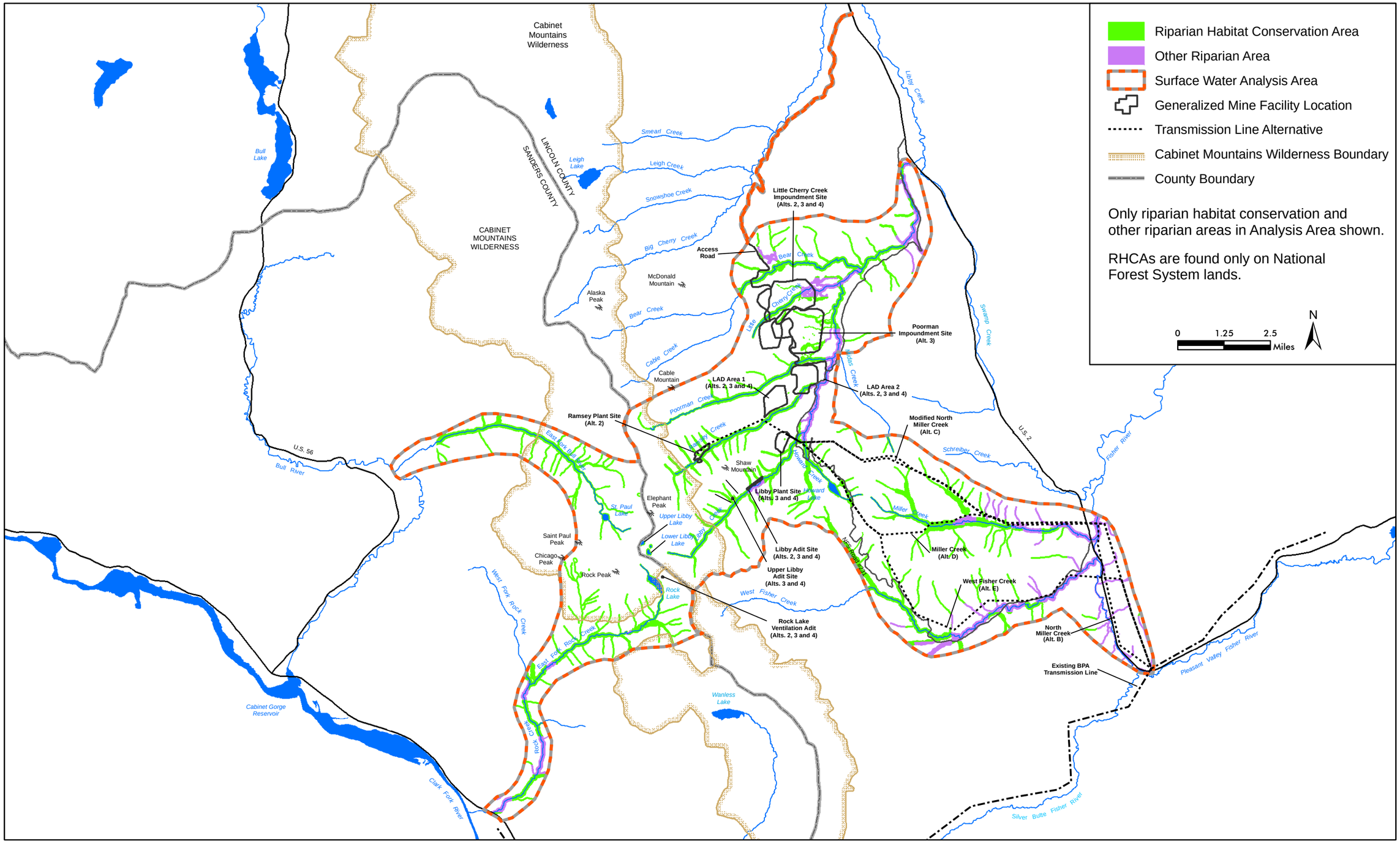


Figure 54. Riparian Habitat Conservation Areas and Other Riparian Areas in the Analysis Area

Type	General Description
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.
C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.
E	Low gradient, meandering riffle/pool stream with low width/depth ratio and little deposition. Very efficient and stable. High meander width ratio.
F	Entrenched meandering riffle/pool channel on low gradients with high width/depth ratio.
G	Entrenched "gully" step/pool and low width/depth ratio on moderate gradients.

Bed Material		Slope	
1	Bedrock	a	Steep slope for stream type
2	Boulder		
3	Cobble	b	Moderate slope for stream type
4	Gravel		
5	Sand	c	Gradual slope for stream type
6	Silt or clay		

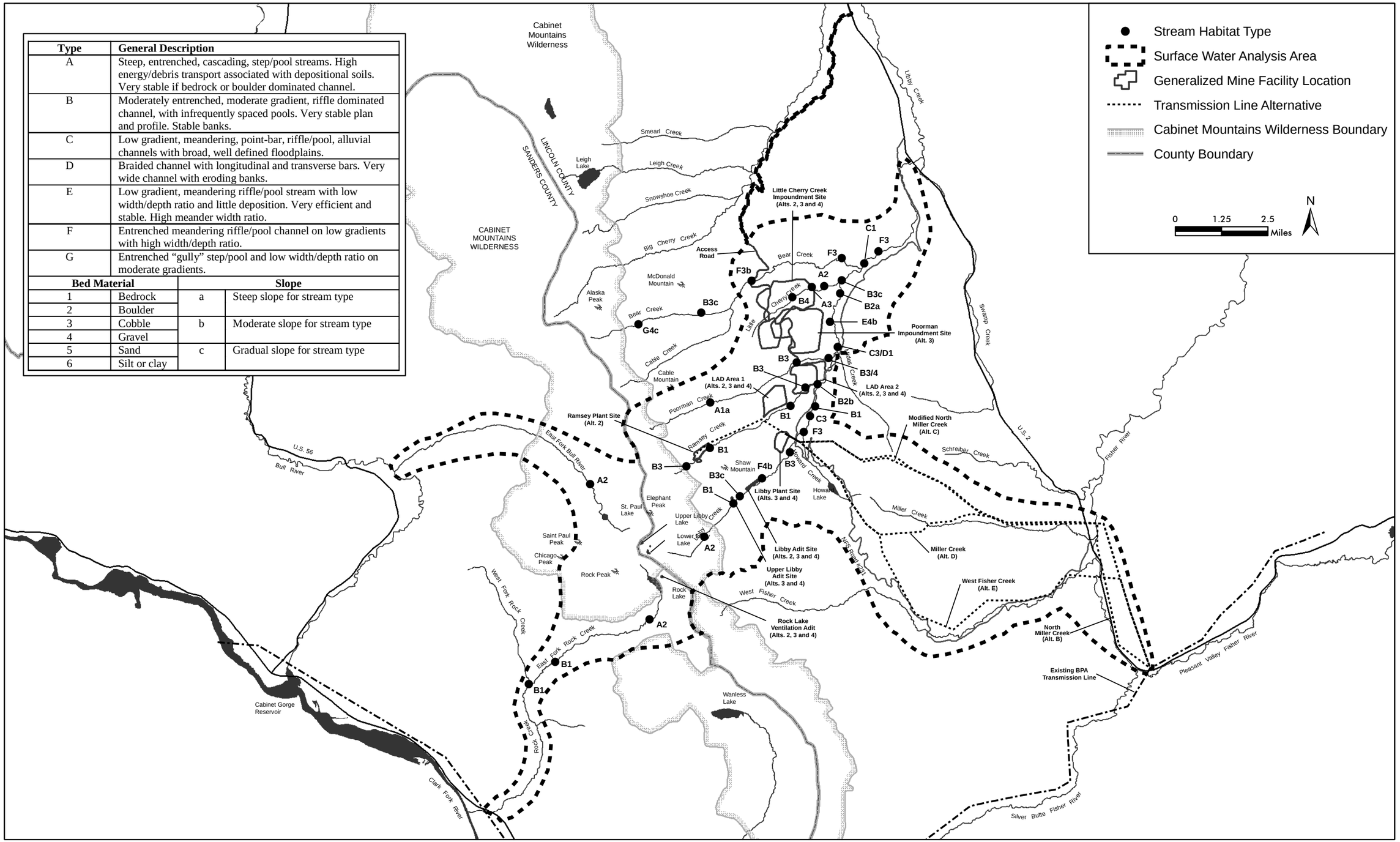


Figure 55. Stream Habitat Types of the Analysis Area Streams

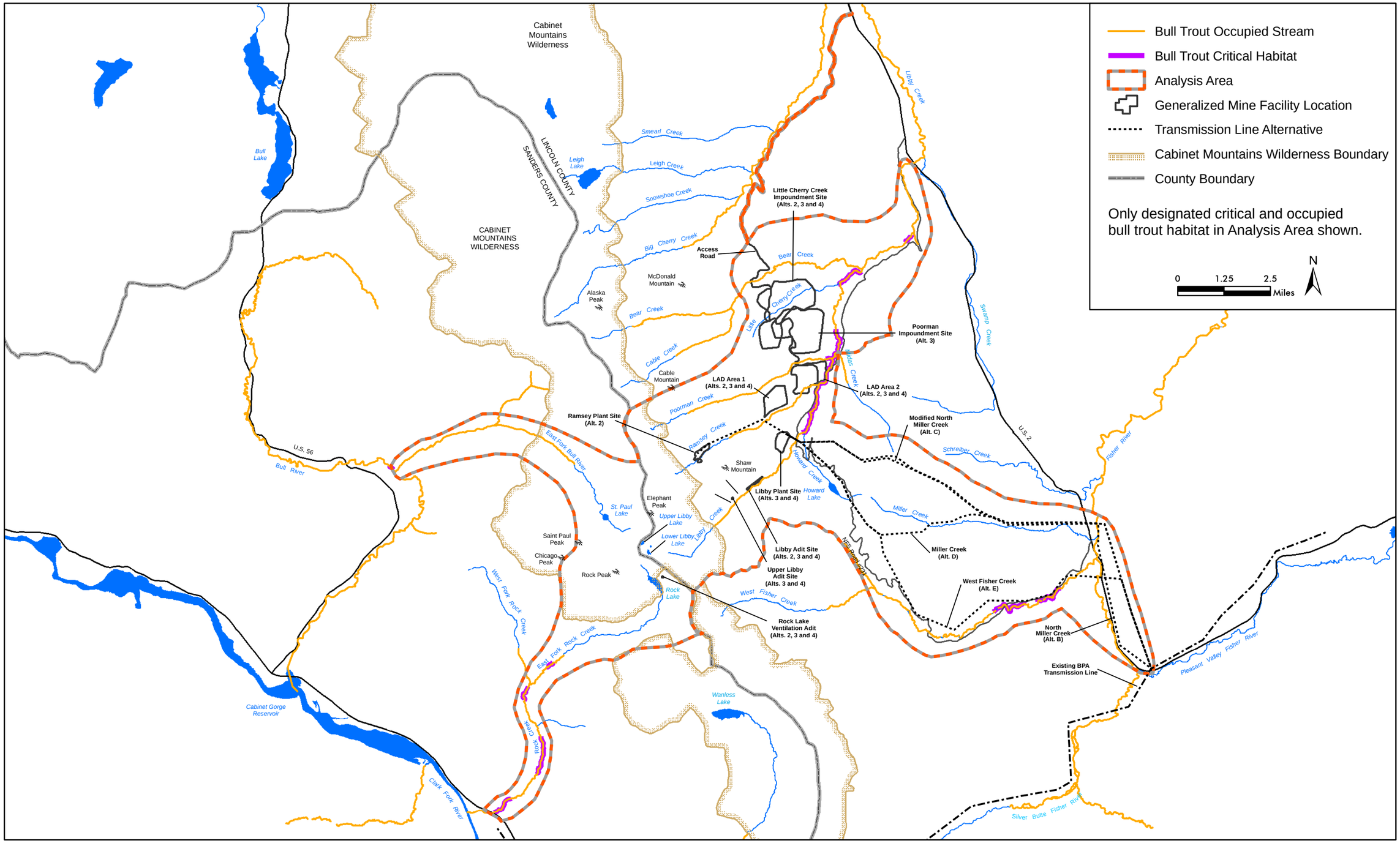


Figure 56. Designated Critical and Occupied Bull Trout Habitat in the Analysis Area Streams

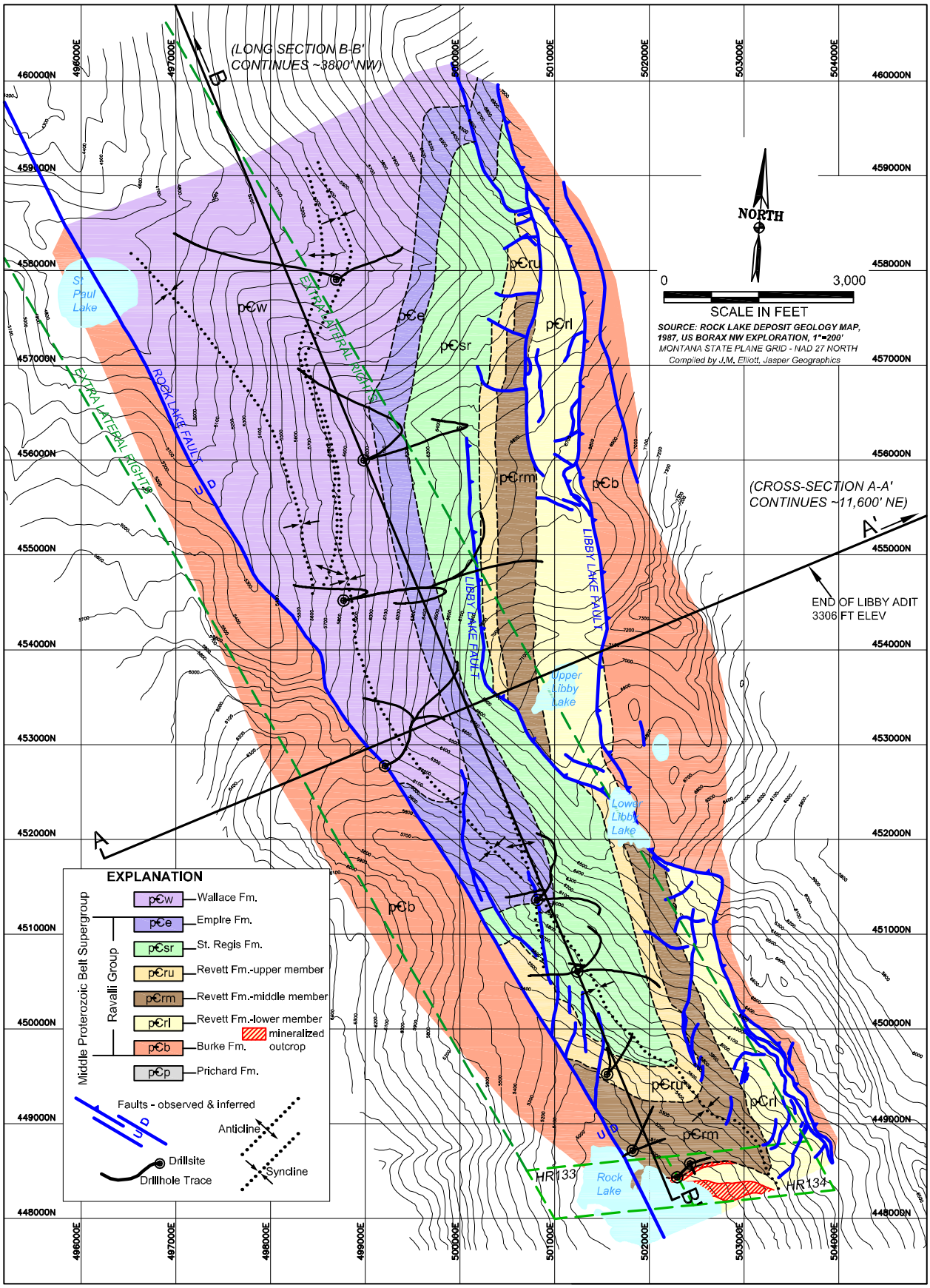


Figure 57. Bedrock Geology of the Rock Creek-Montanore Deposit

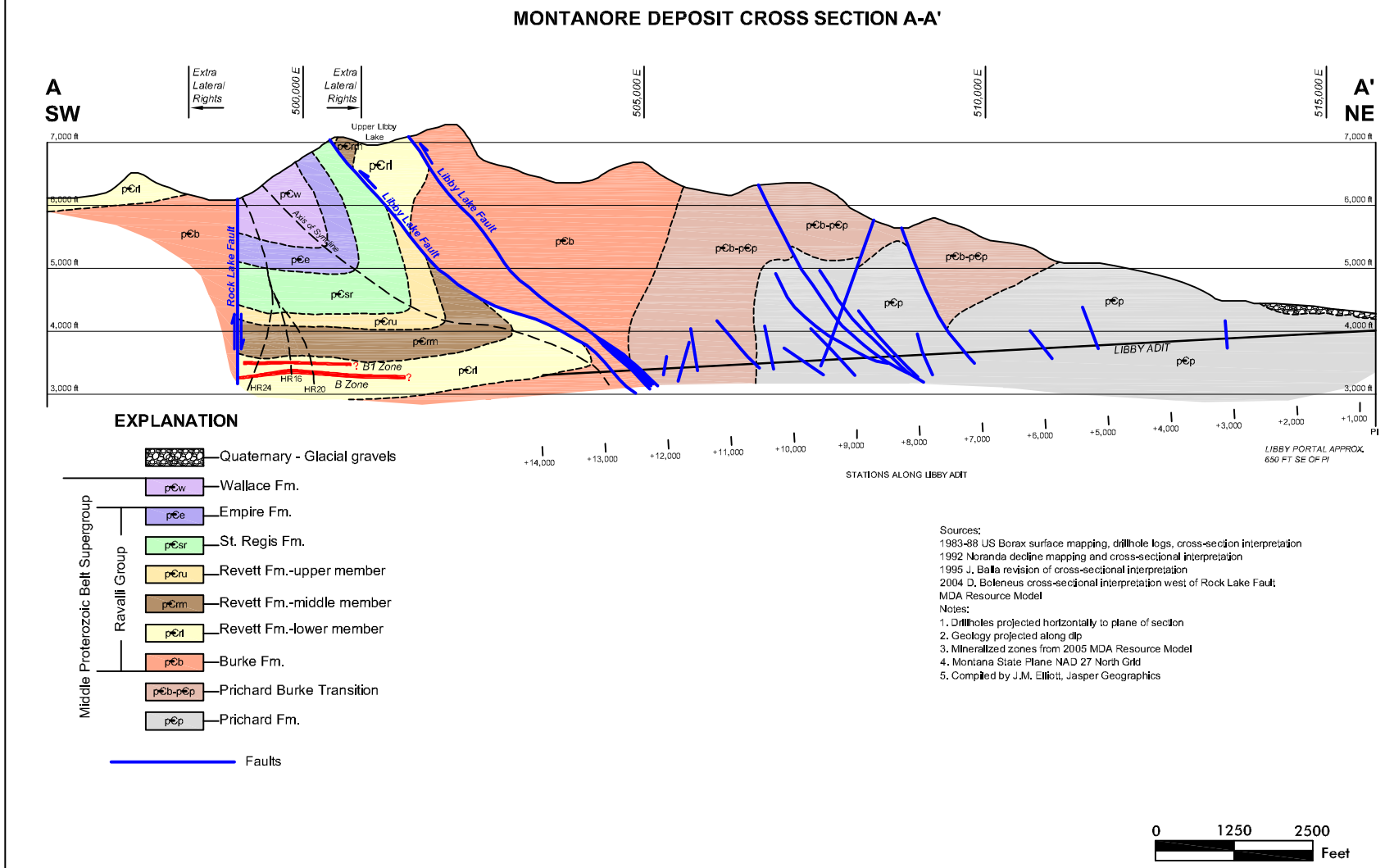


Figure 58. Geologic Cross Section-Libby Adit

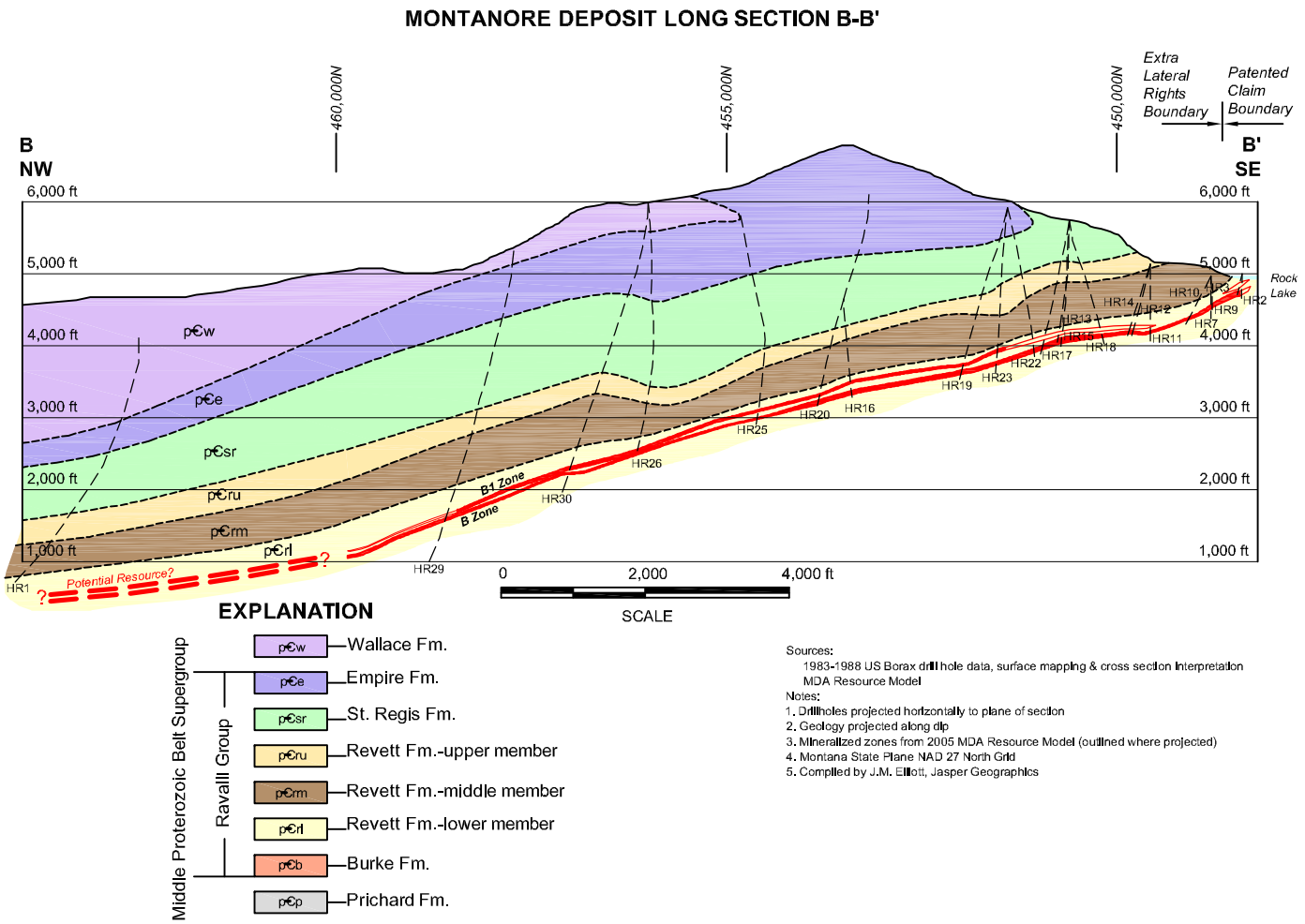


Figure 59. Geologic Cross Section-Montanore Sub-deposit

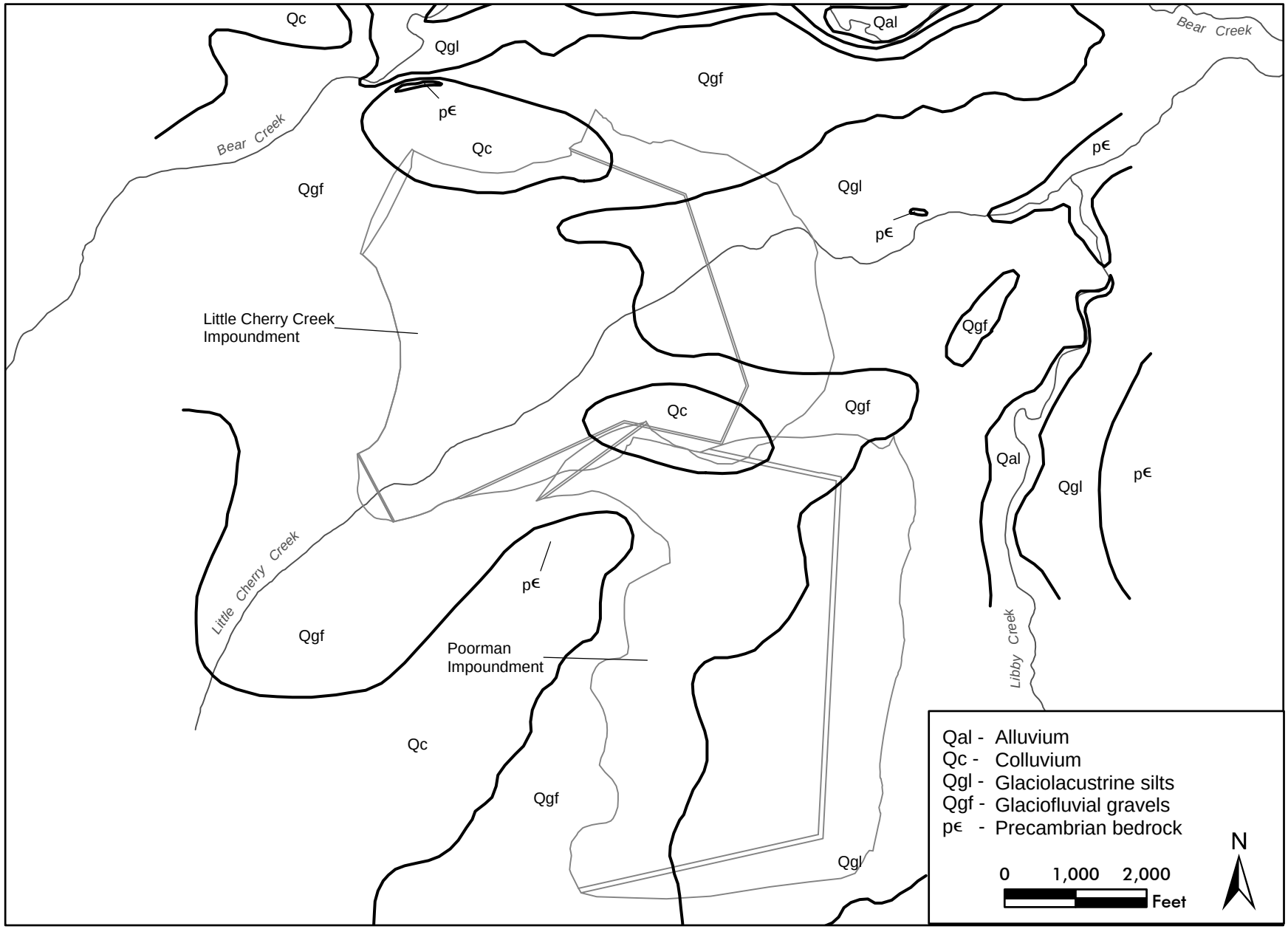


Figure 60. Geology of the Two Tailings Impoundment Areas

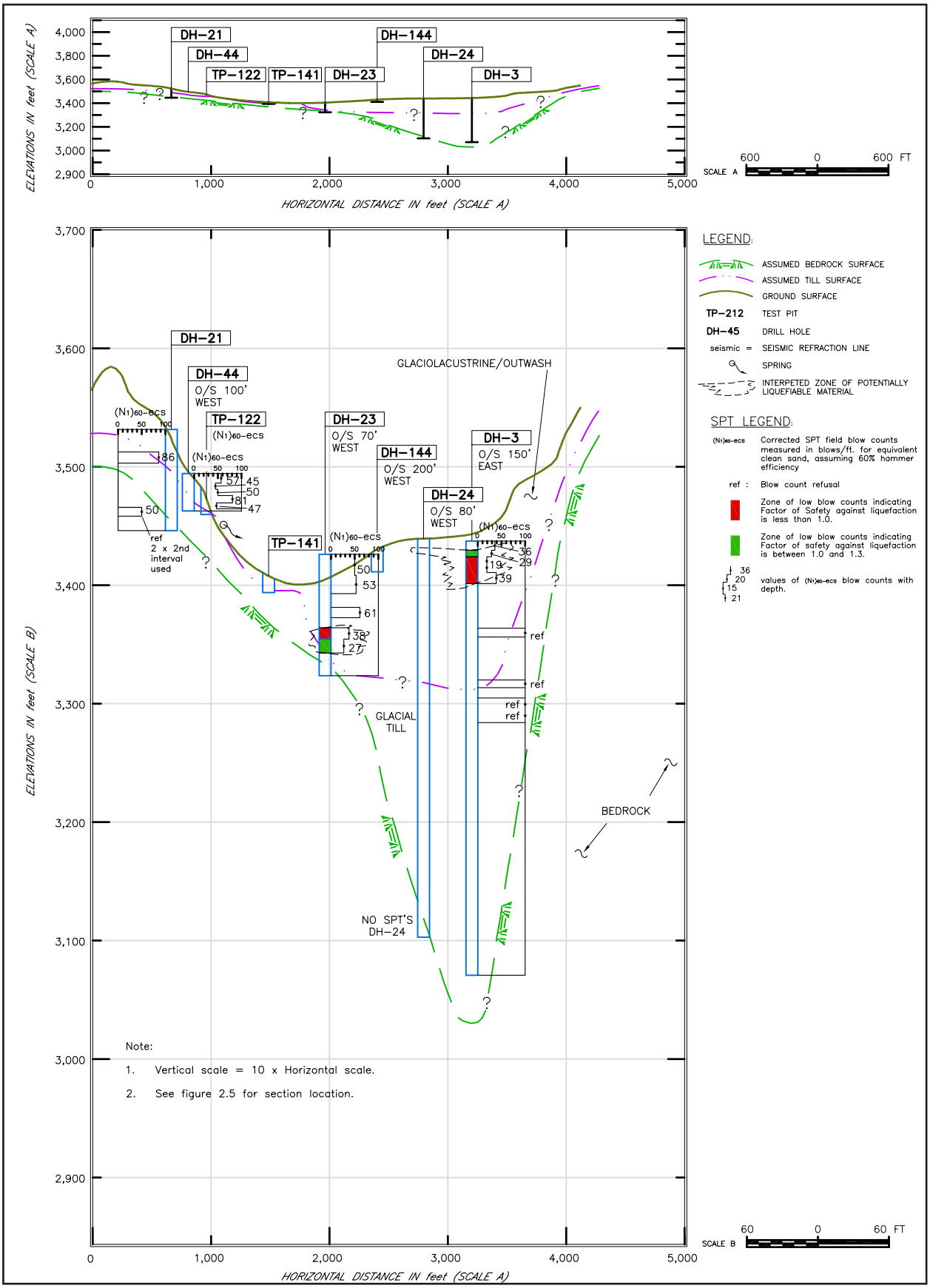
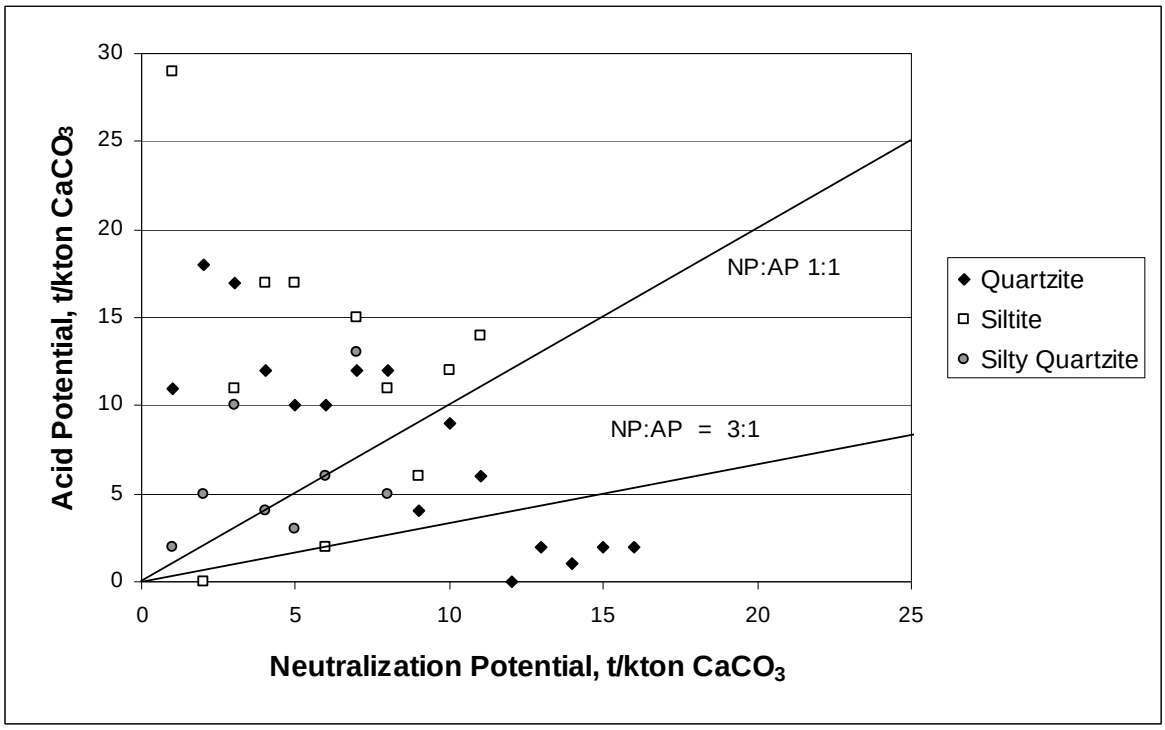


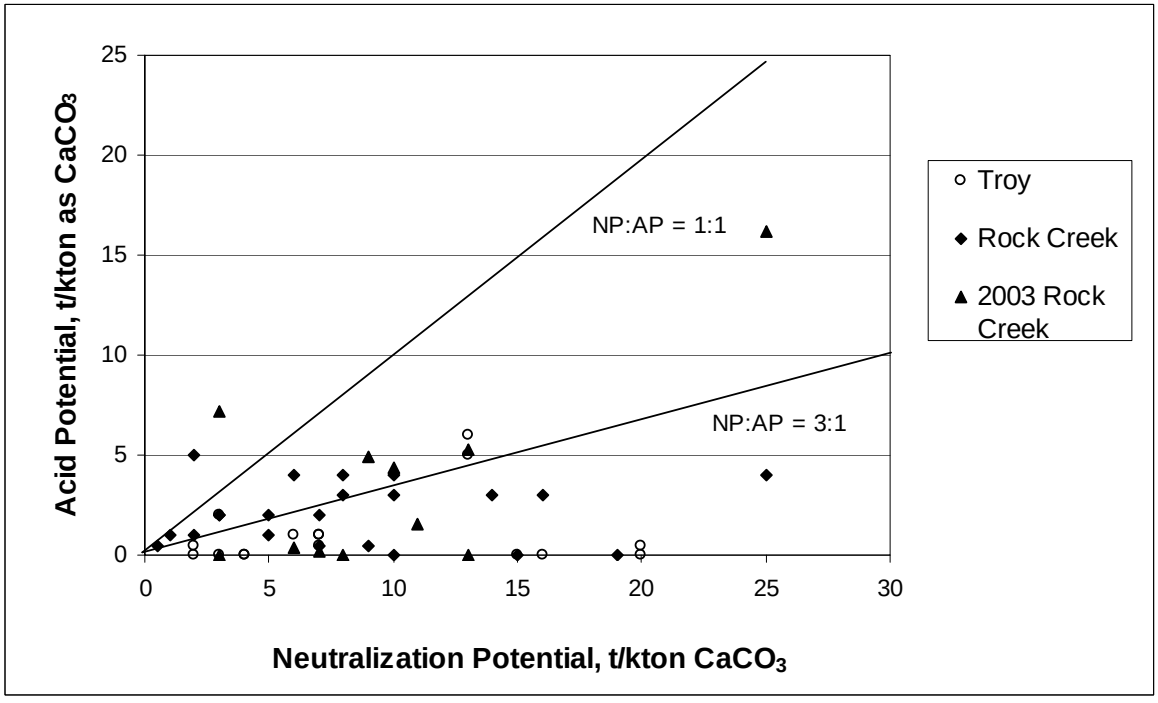
Figure 61. Geologic Cross Section of the Little Cherry Creek Tailings Impoundment Site

Figure 62. Acid Generation Potential of the Montanore Sub-Deposit Ore.



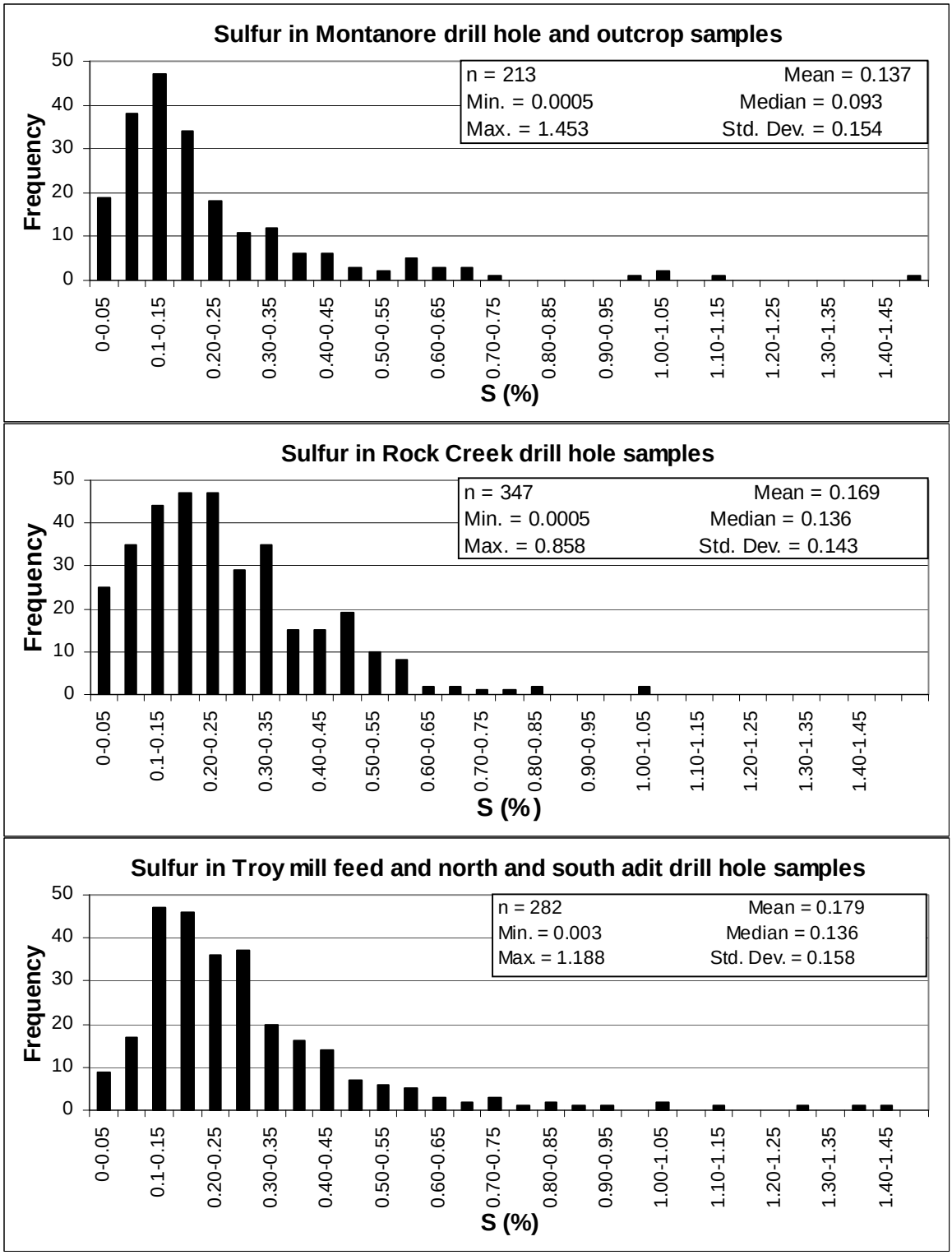
Source: Enviromin 2007

Figure 63. Acid Generation Potential of Ore, from the Rock Creek Sub-deposit and Troy Deposit.



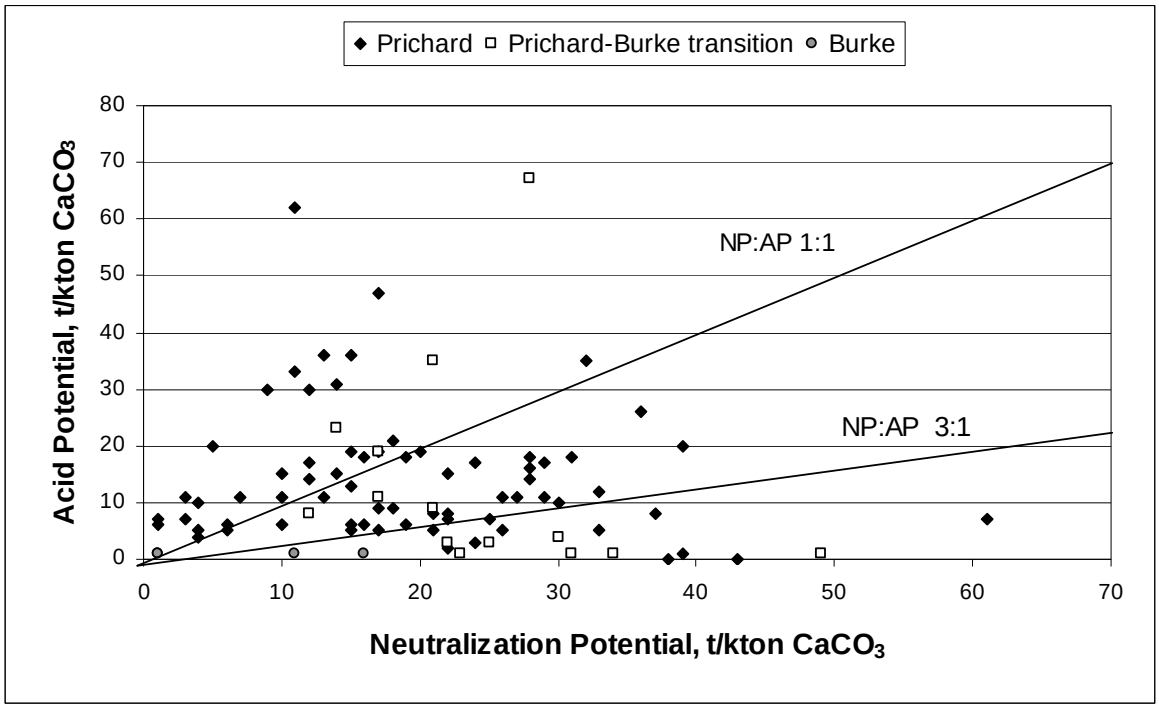
Source: Enviromin 2007

Figure 64. Distribution of Sulfide Calculated Based on Copper Assays for Montanore, Rock Creek, and Troy Deposits.



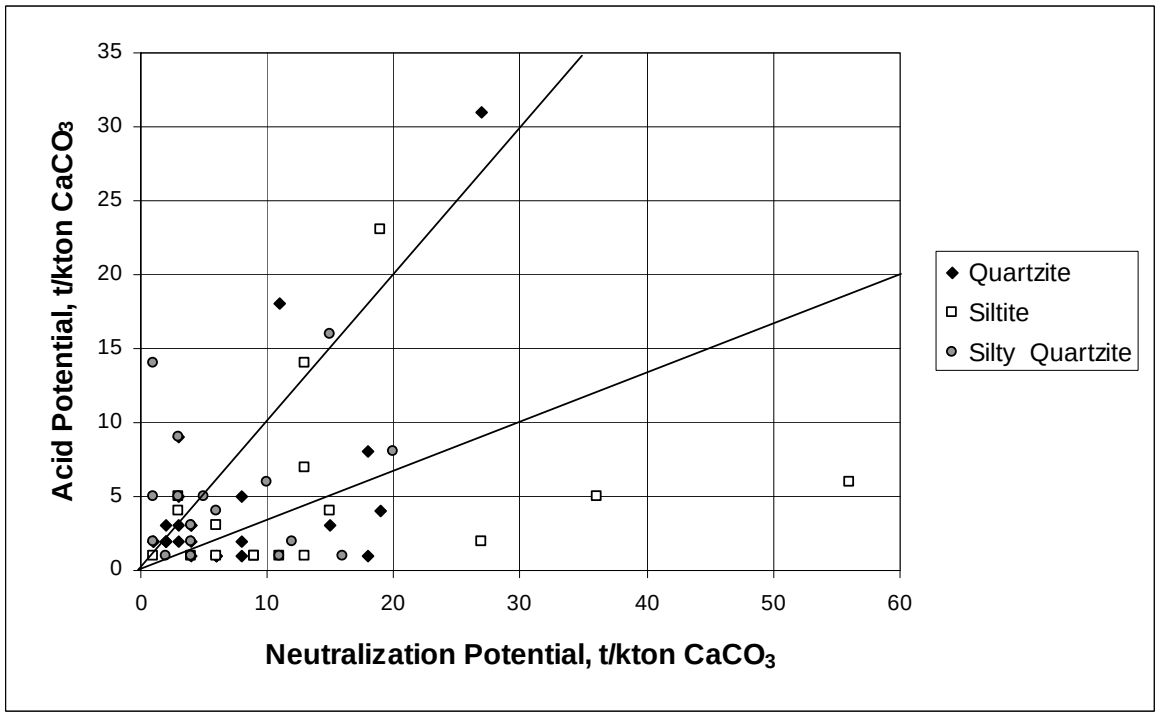
Source: Enviromin 2007

Figure 65. Acid Generation Potential of Waste Rock, Libby Adit, Montanore.



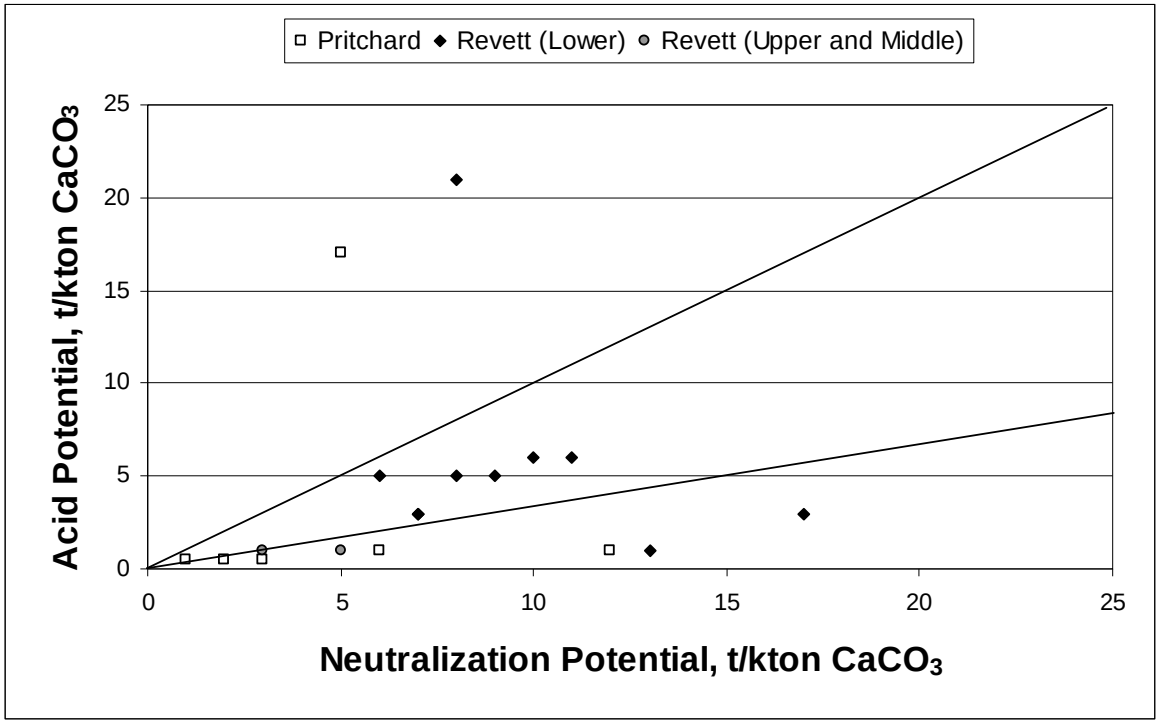
Source: Enviromin 2007.

Figure 66. Acid Generation Potential of Rock Creek and Troy Revett Waste Rock.



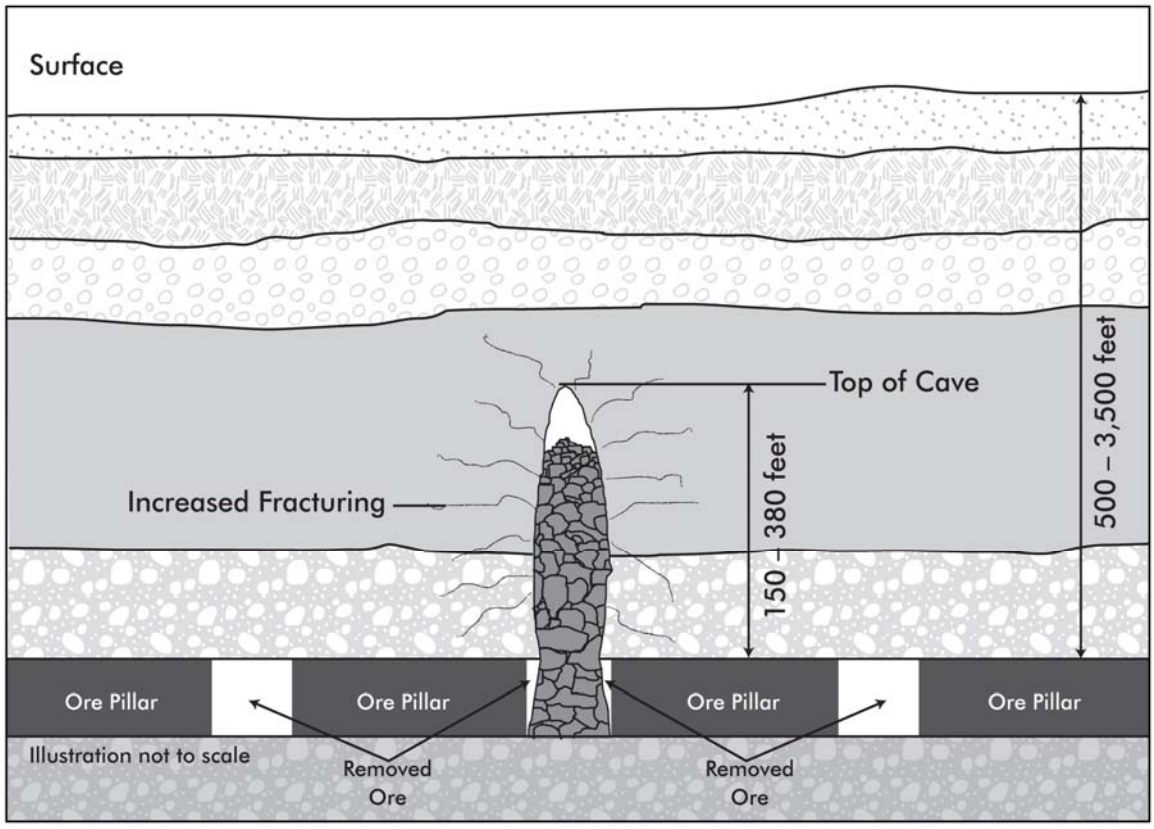
Source: Enviromin 2007.

Figure 67. Acid Generation Potential of Rock Creek and Troy Waste Rock Samples by Formation.



Source: Enviromin 2007
Note: sulfide adjusted to account for acid consuming copper sulfide minerals.

Figure 68. Typical Cross Sectional View of Chimney Subsidence.



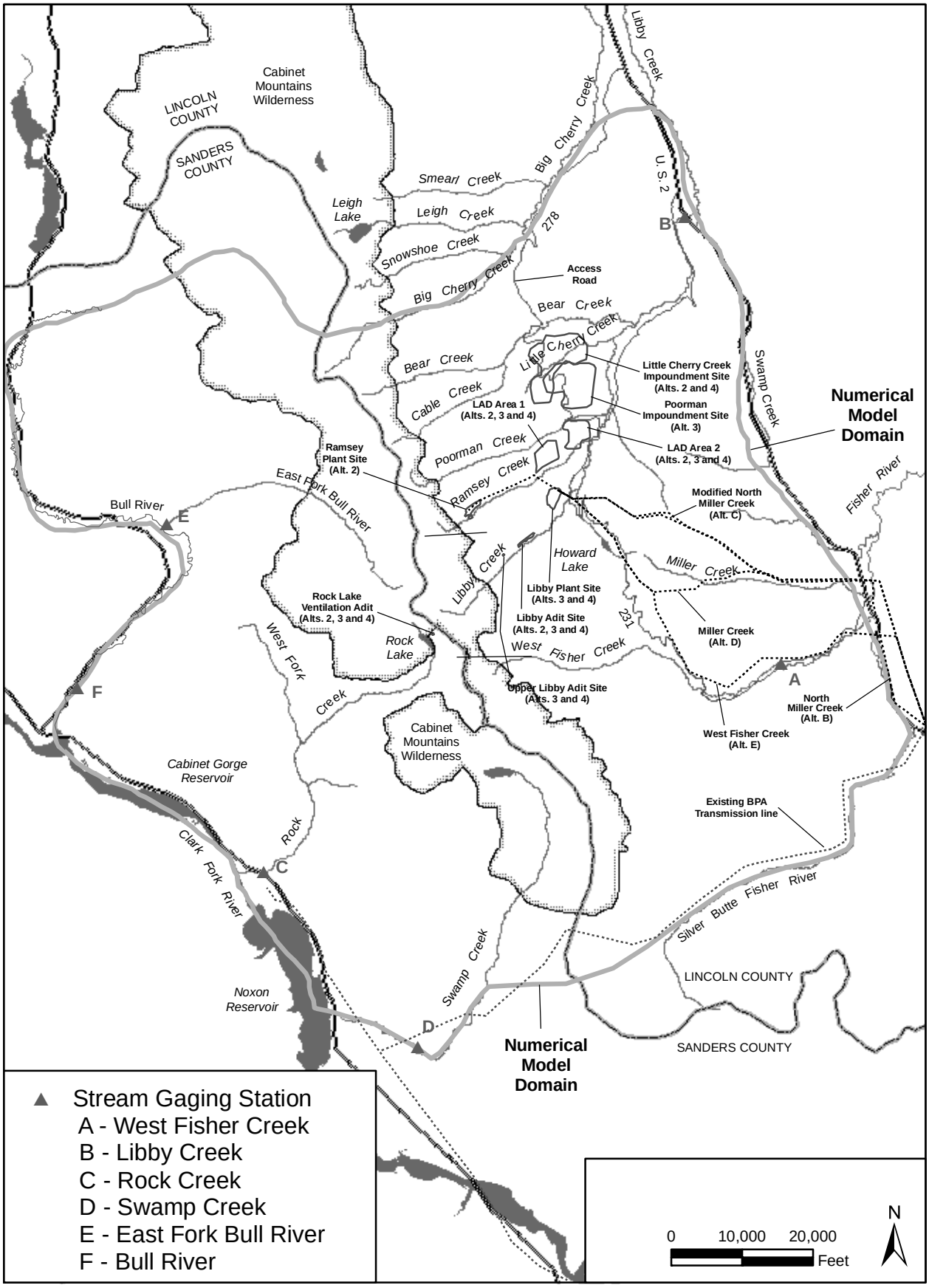


Figure 69. Numerical Model Domain and Project Area Location

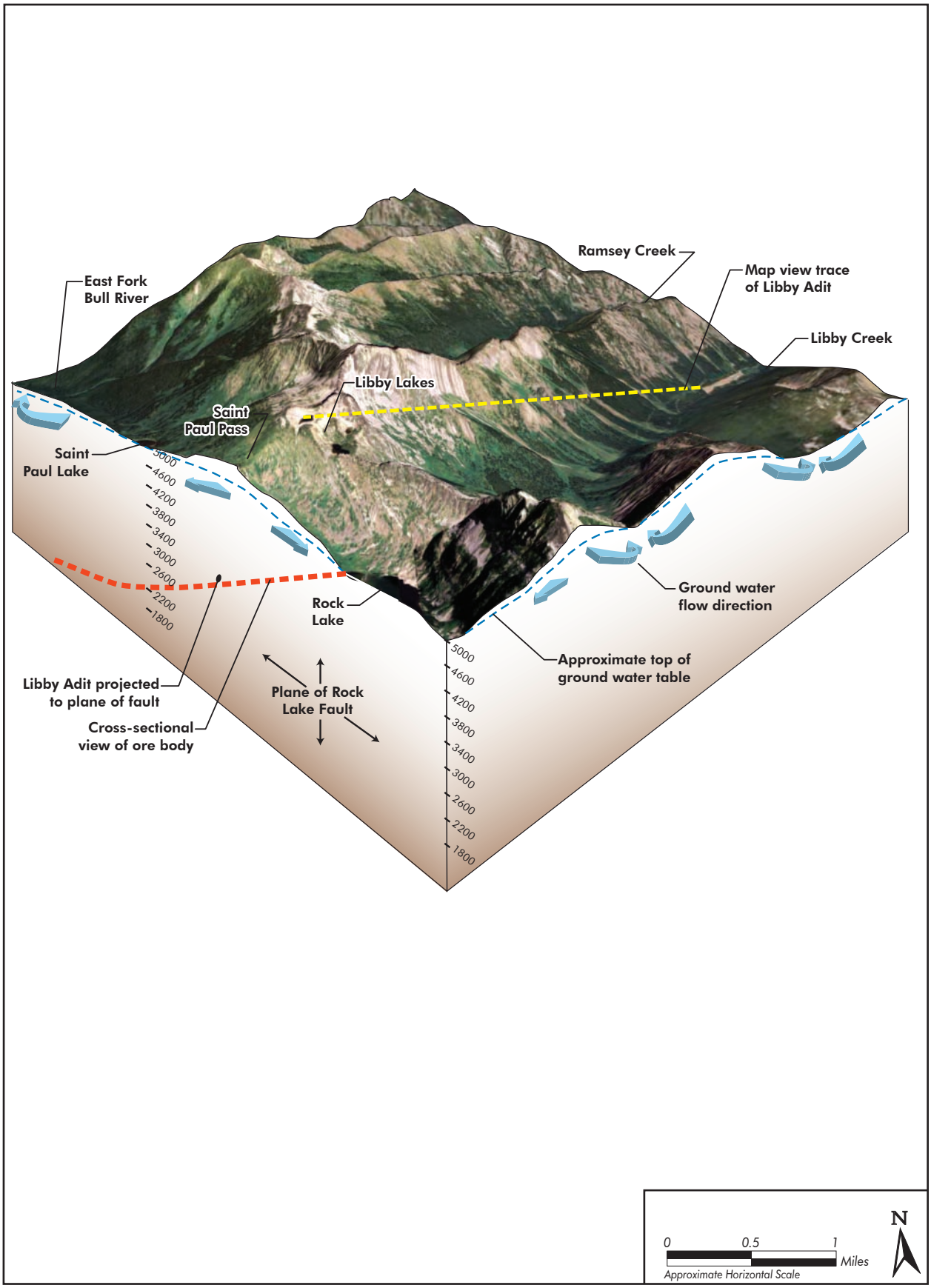


Figure 70. Agencies' Three Dimensional Conceptual Model of the Montanore Mine Area Hydrogeology

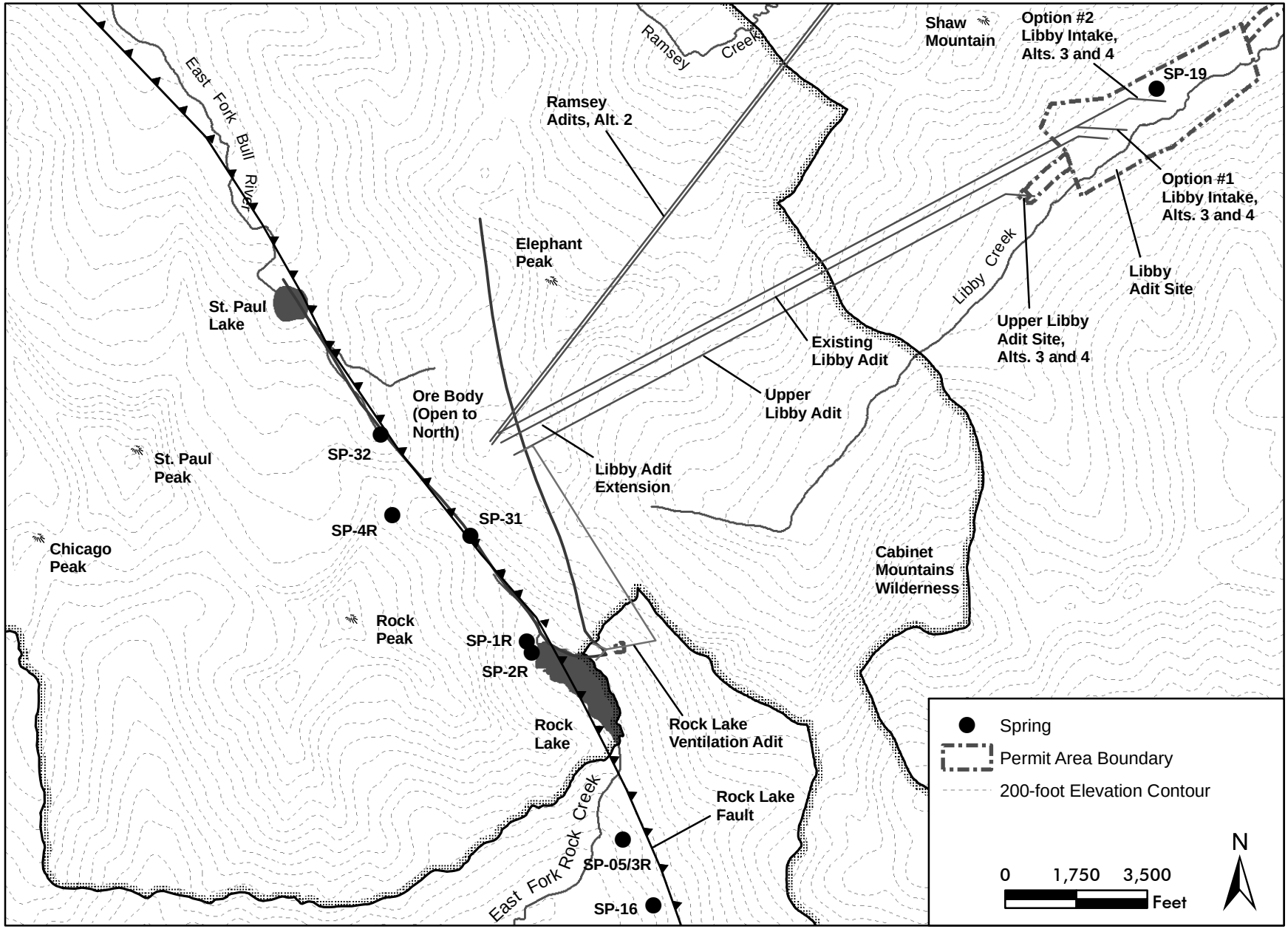


Figure 71. Identified Springs in the Mine Area

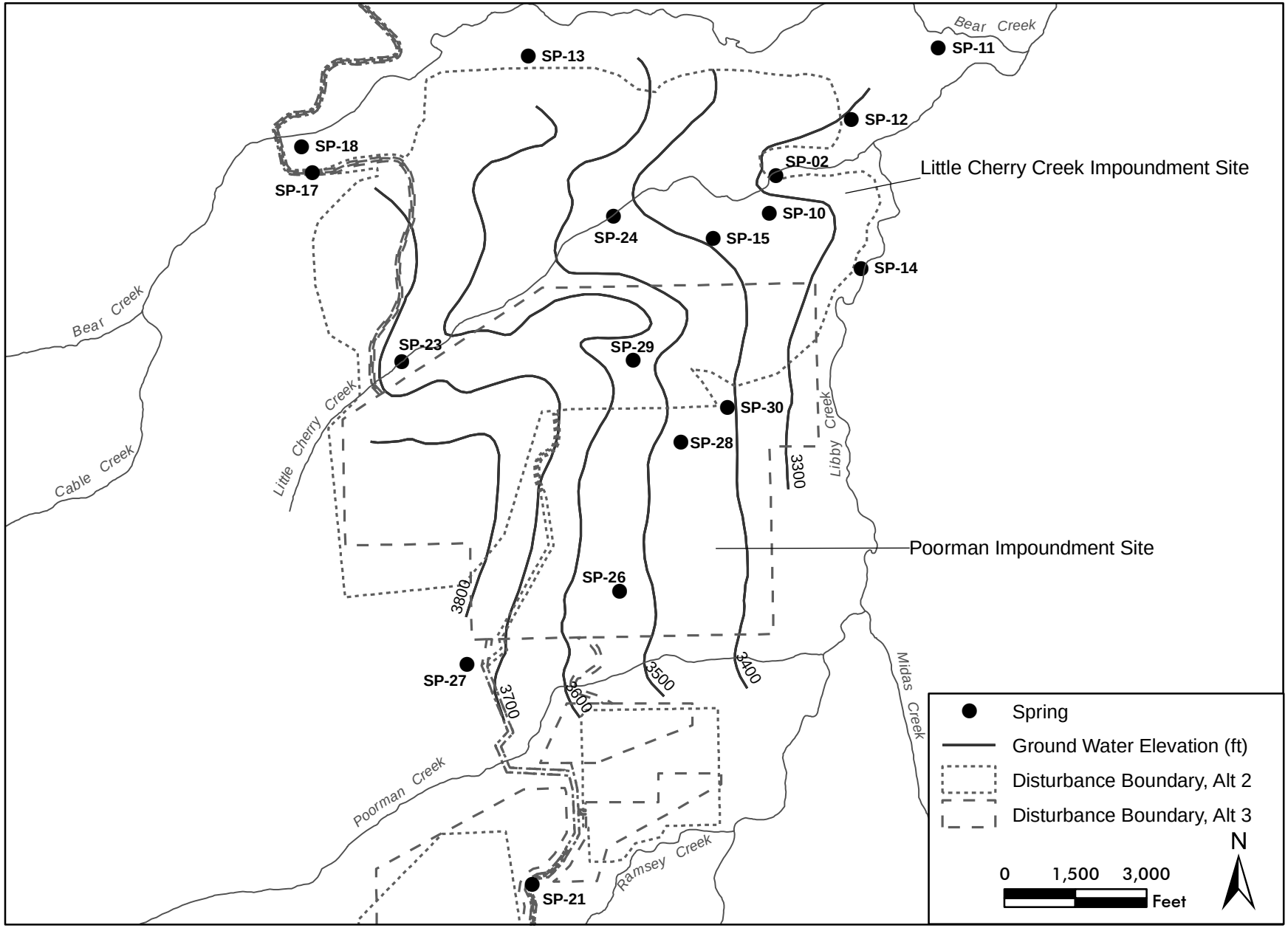


Figure 72. Identified Springs and Ground Water Levels in the Tailings Impoundment Sites

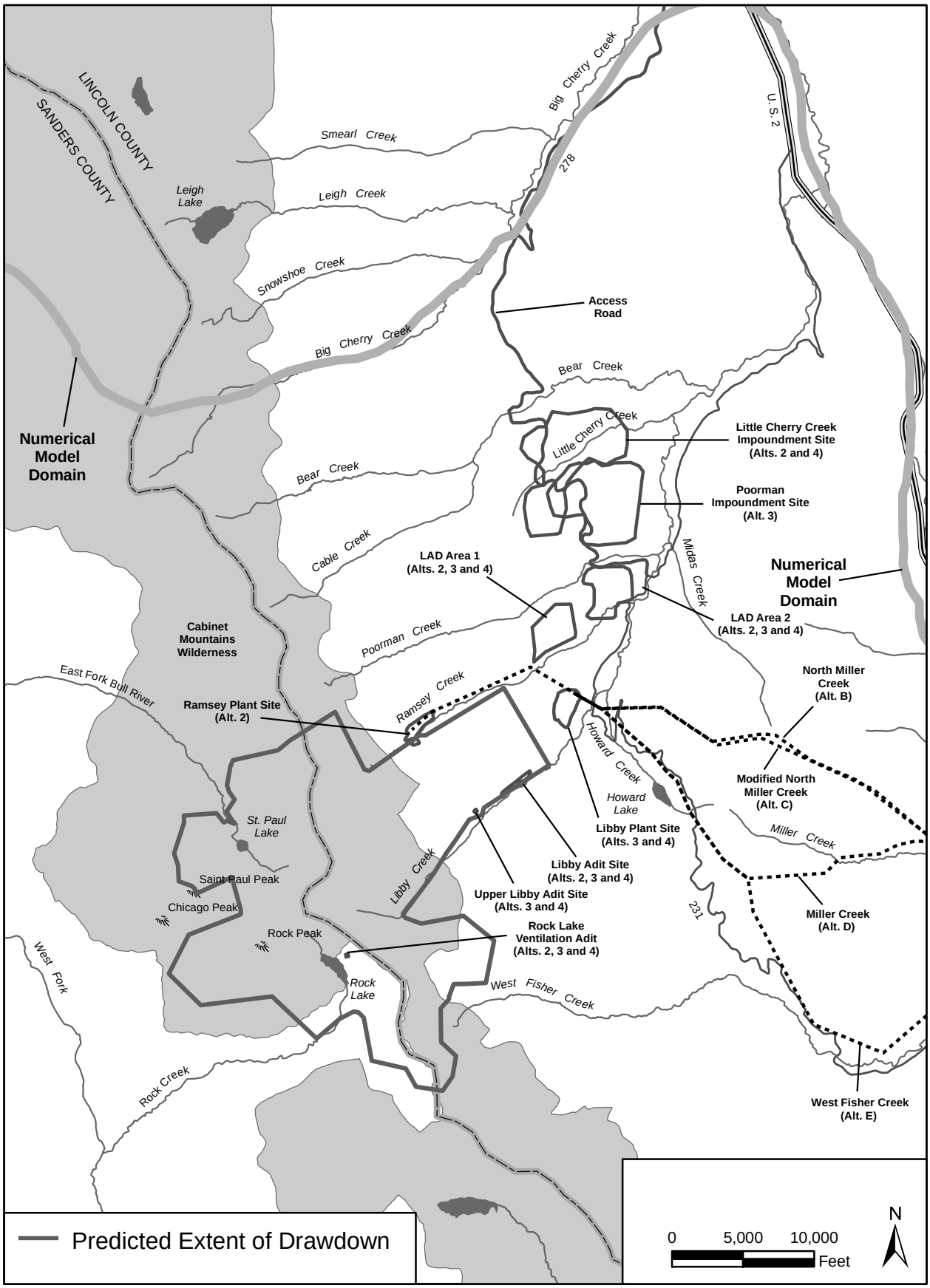


Figure 73. Predicted Area of Ground Water Drawdown During Mining

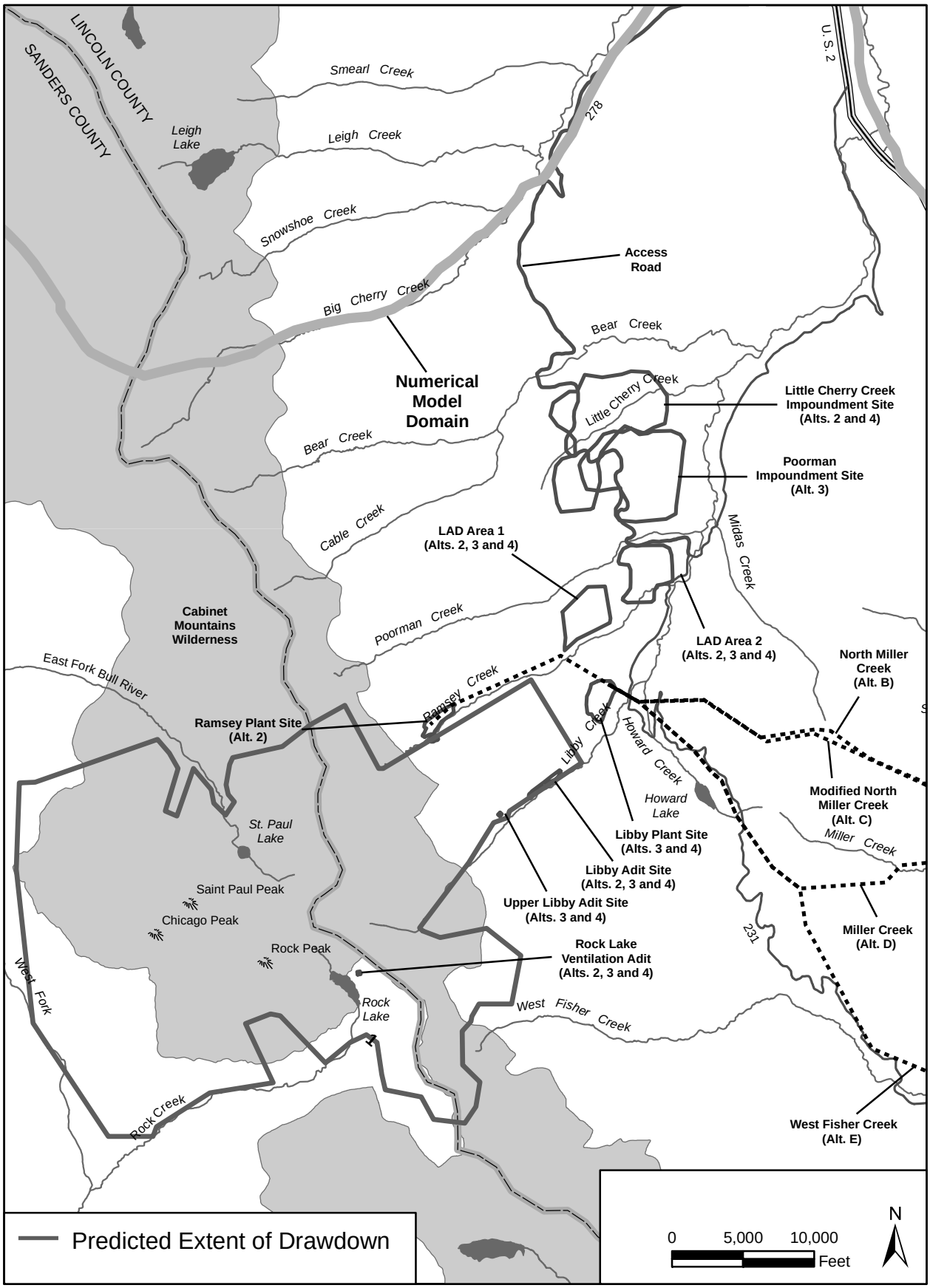


Figure 74. Predicted Area of Cumulative Ground Water Drawdown During Mining

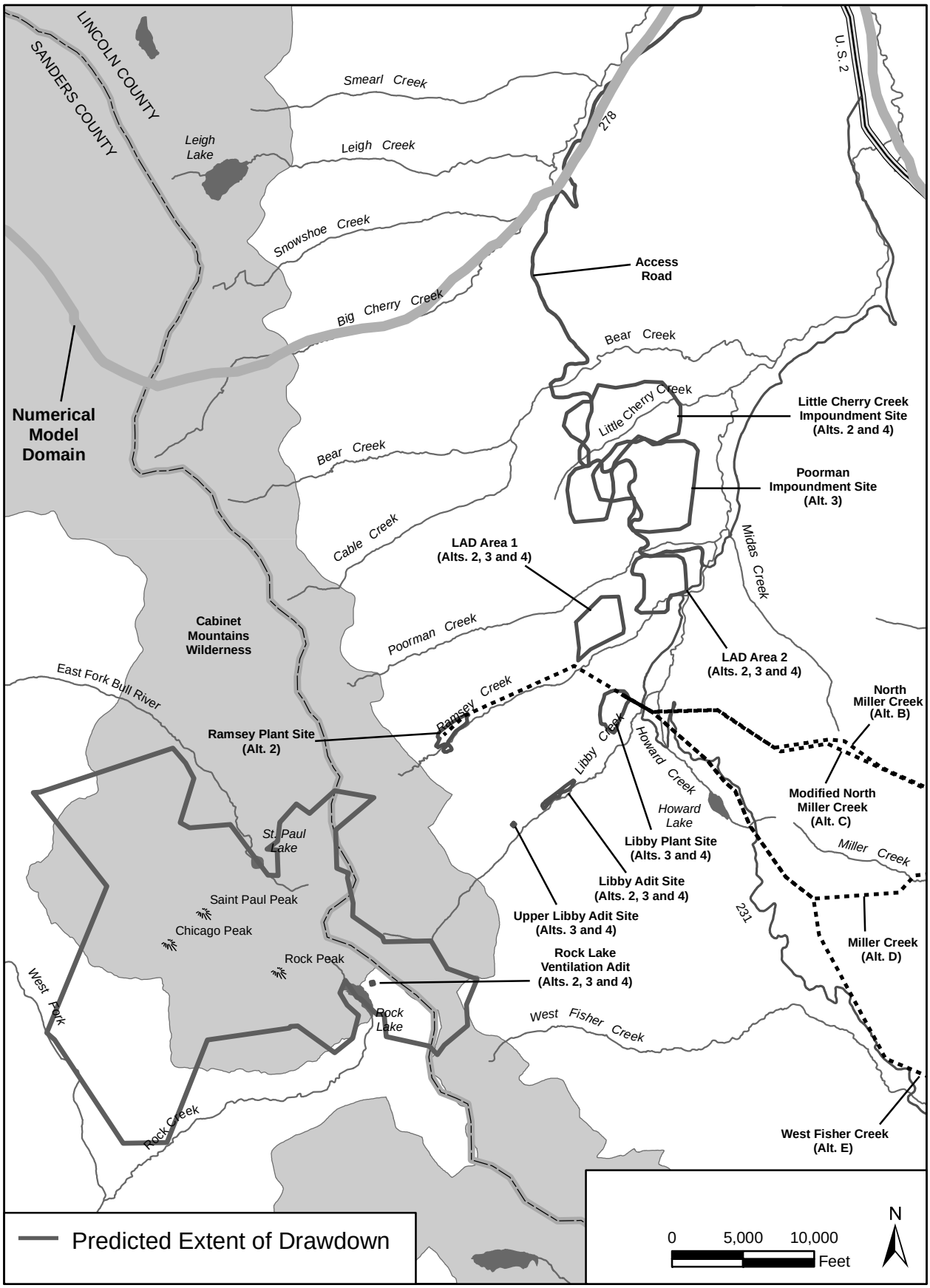


Figure 75. Predicted Area of Cumulative Ground Water Drawdown Post-mining

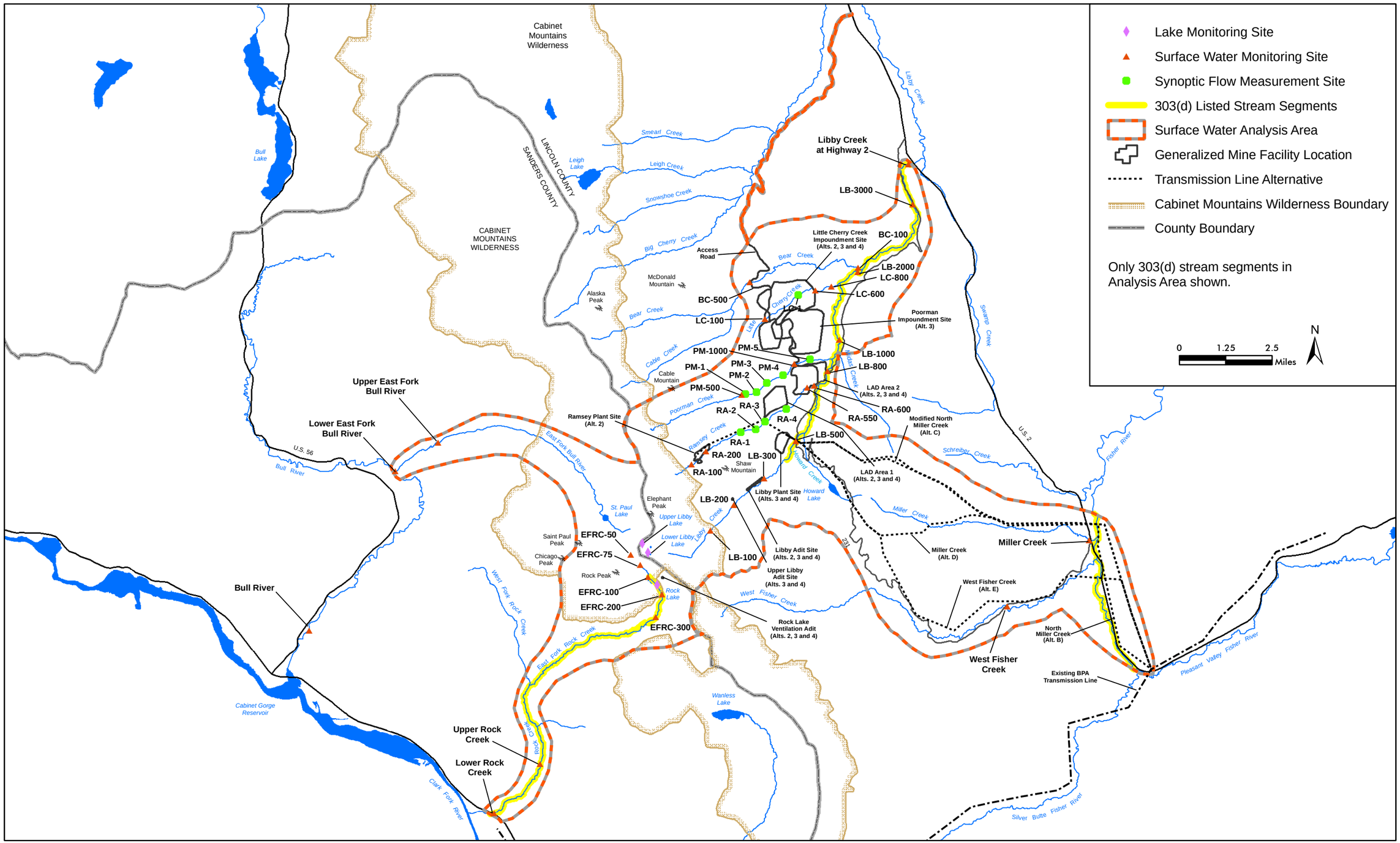


Figure 76. Surface Water Resources in the Analysis Area

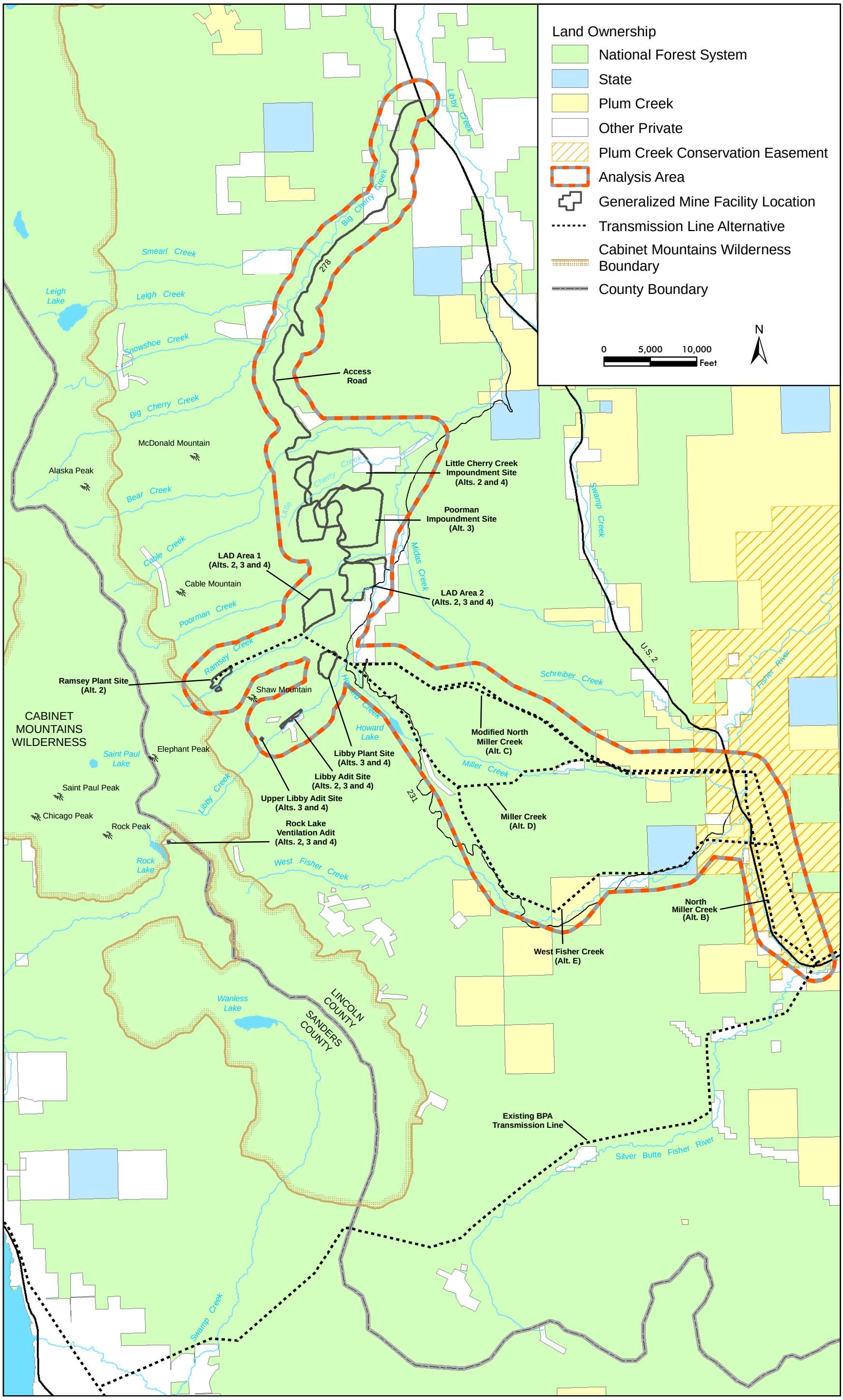


Figure 77. Land Ownership in the Analysis Area

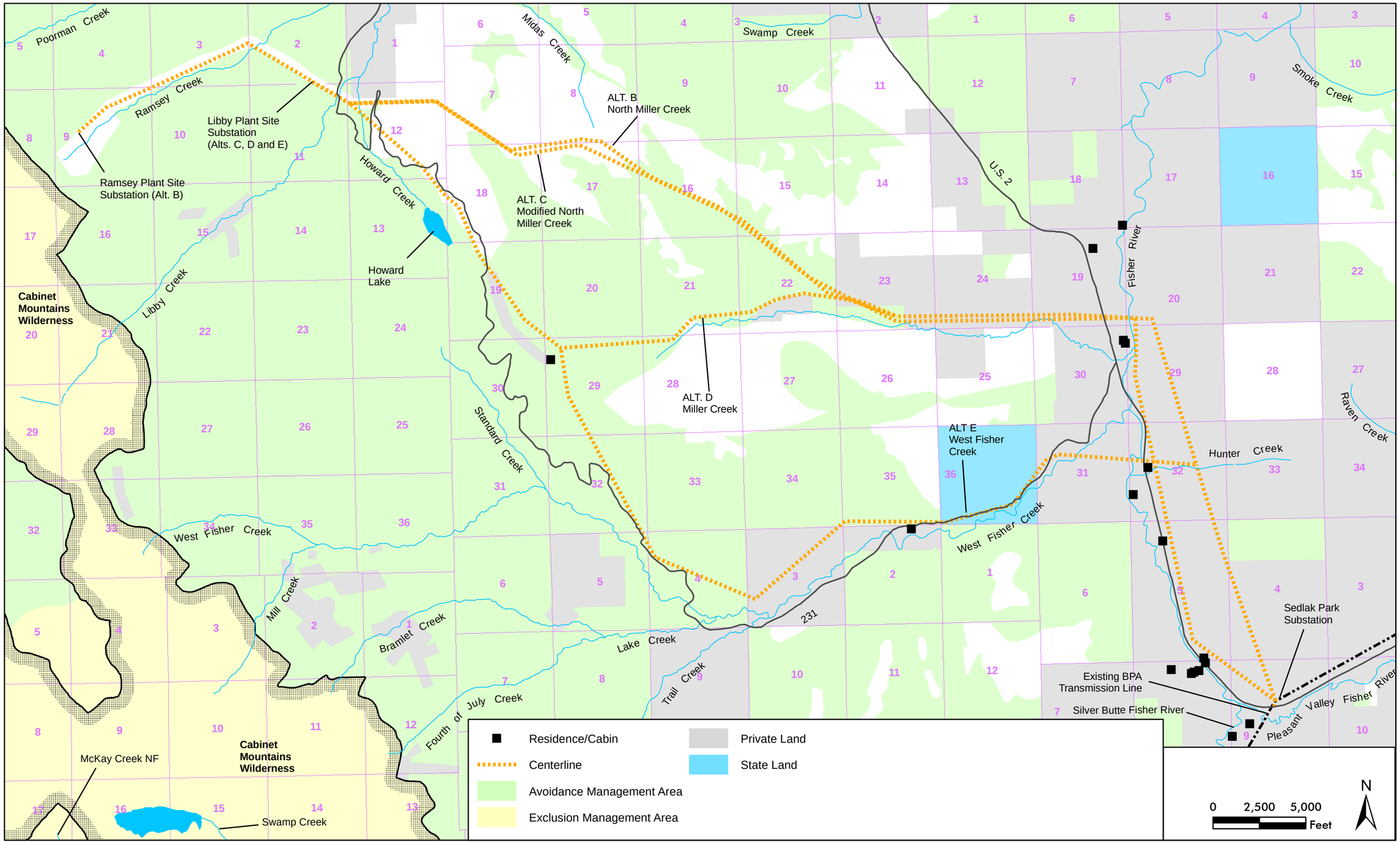


Figure 78. Residences, Corridor Exclusion Management Areas, and Corridor Avoidance Management Areas Along Transmission Line Alternatives

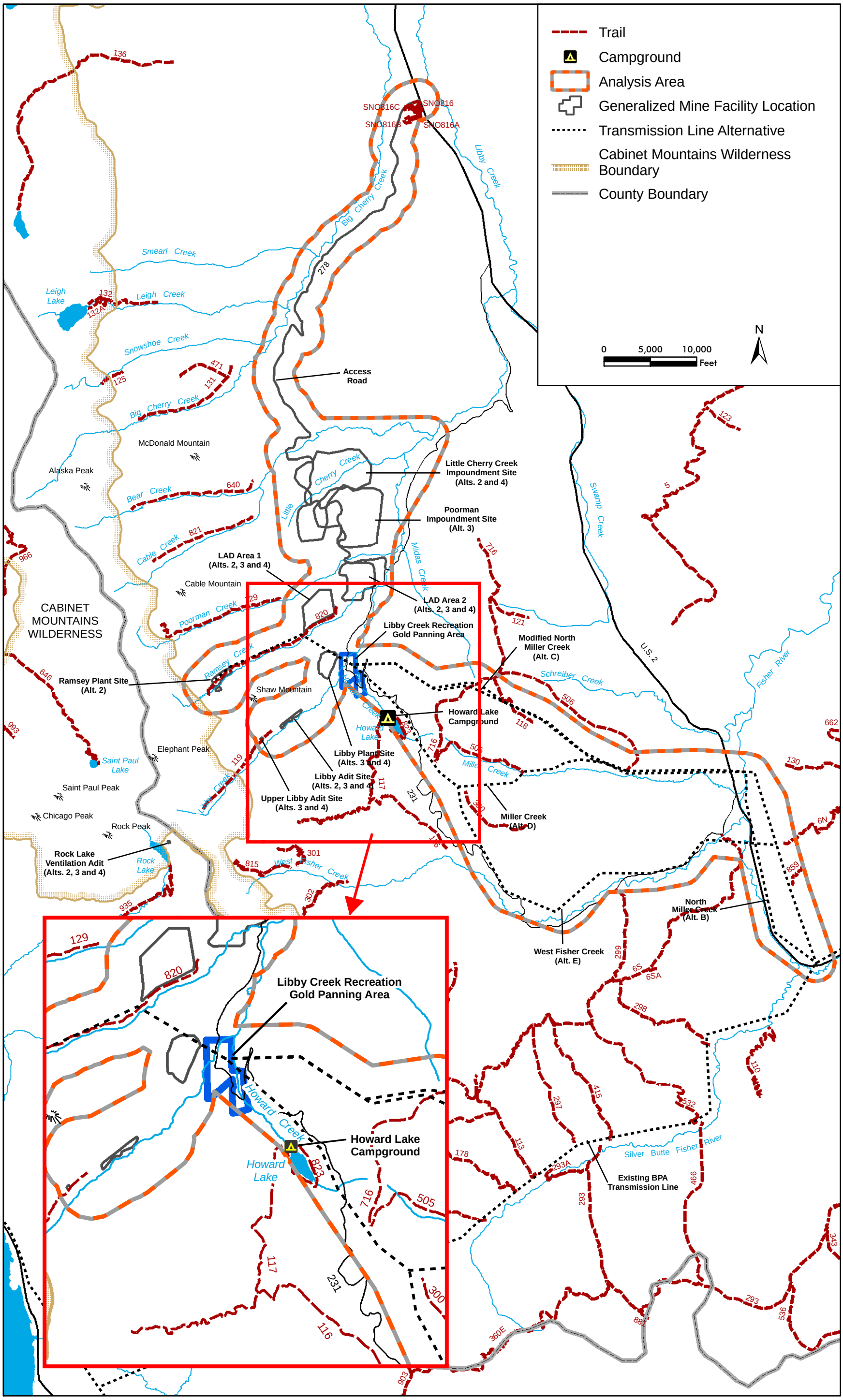


Figure 79. Key Recreation Resources in the Analysis Area

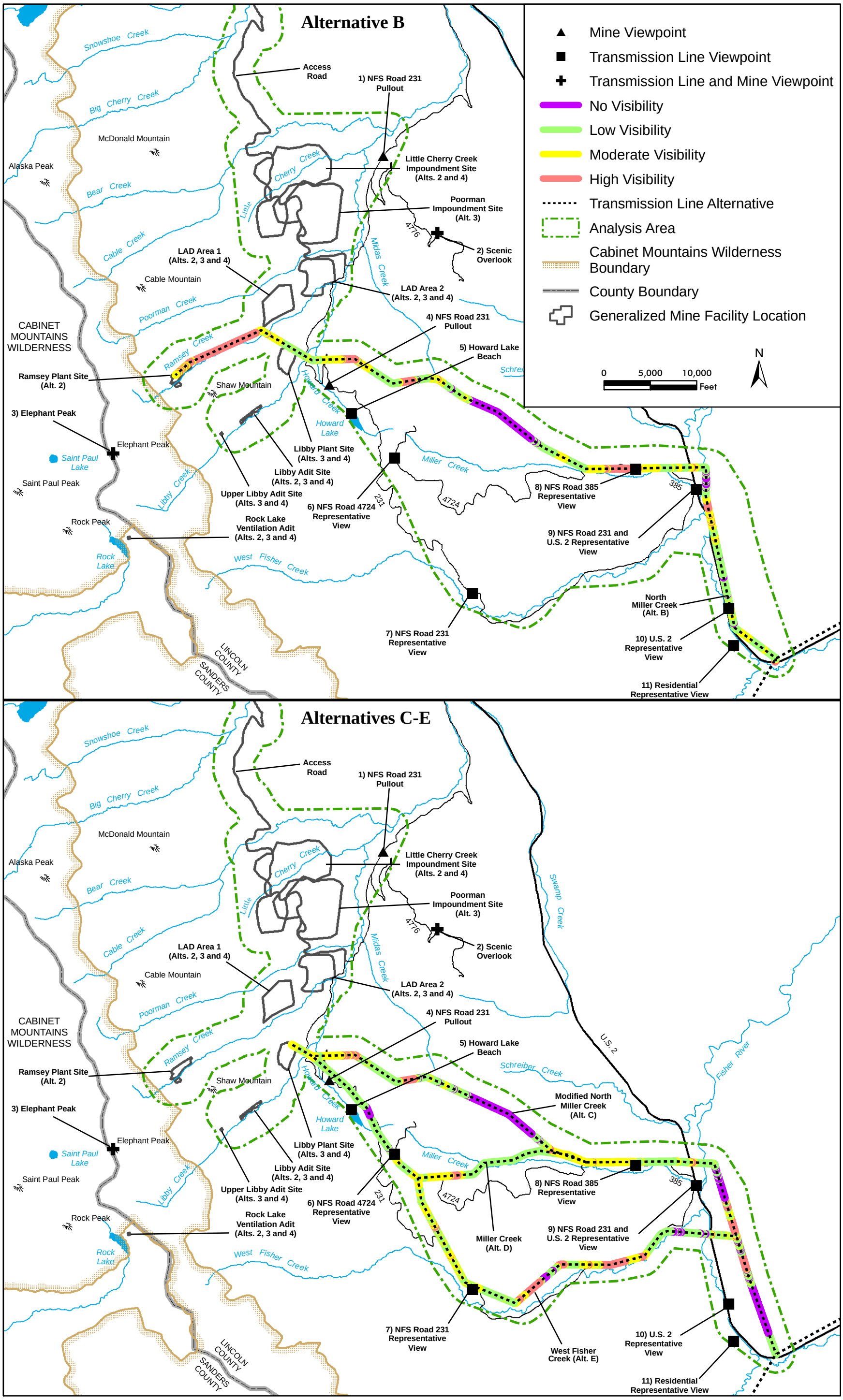


Figure 80. Transmission Line Segments Visible from KOPs, Roads and the CMW

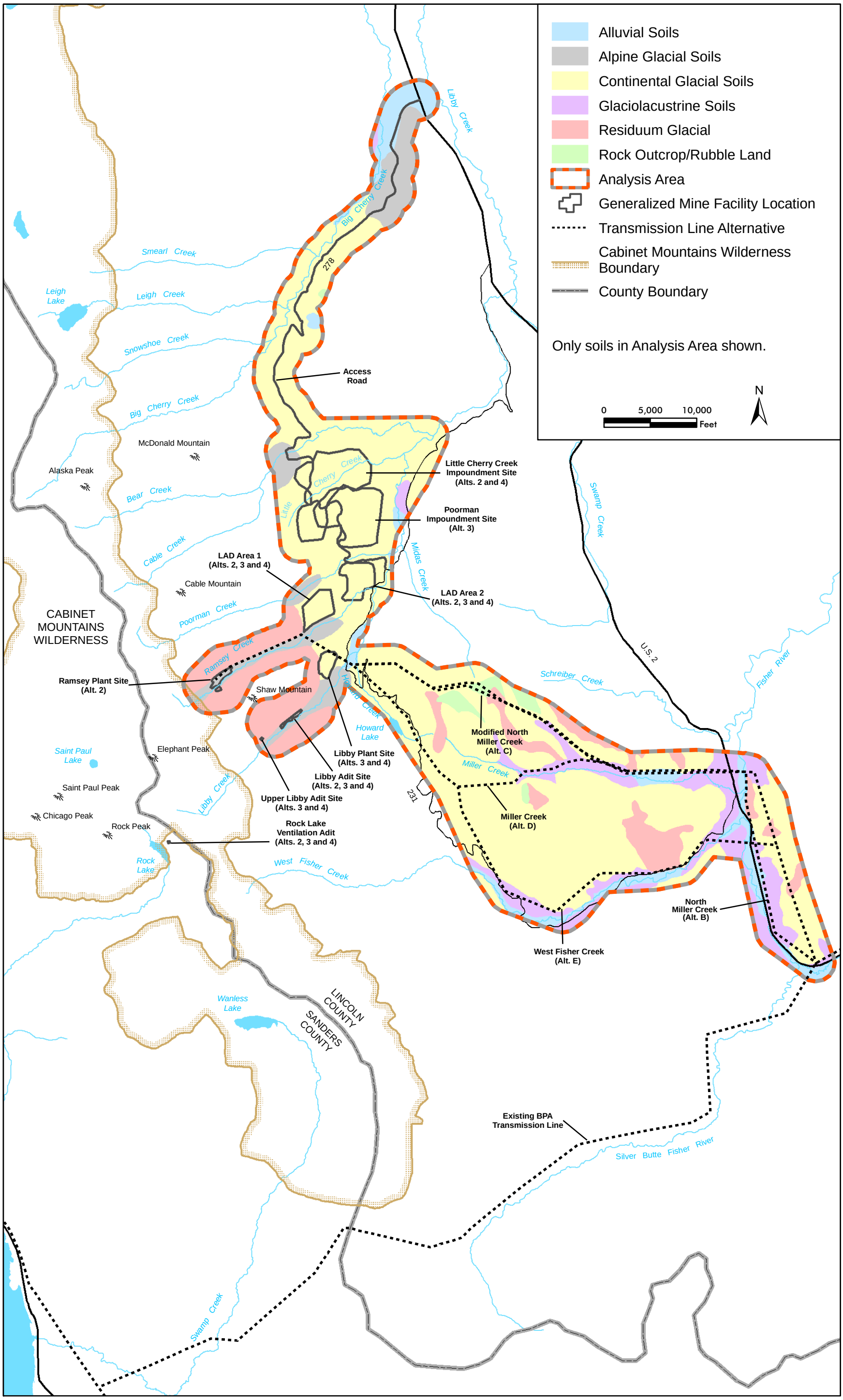


Figure 81. General Soil Types in the Analysis Area

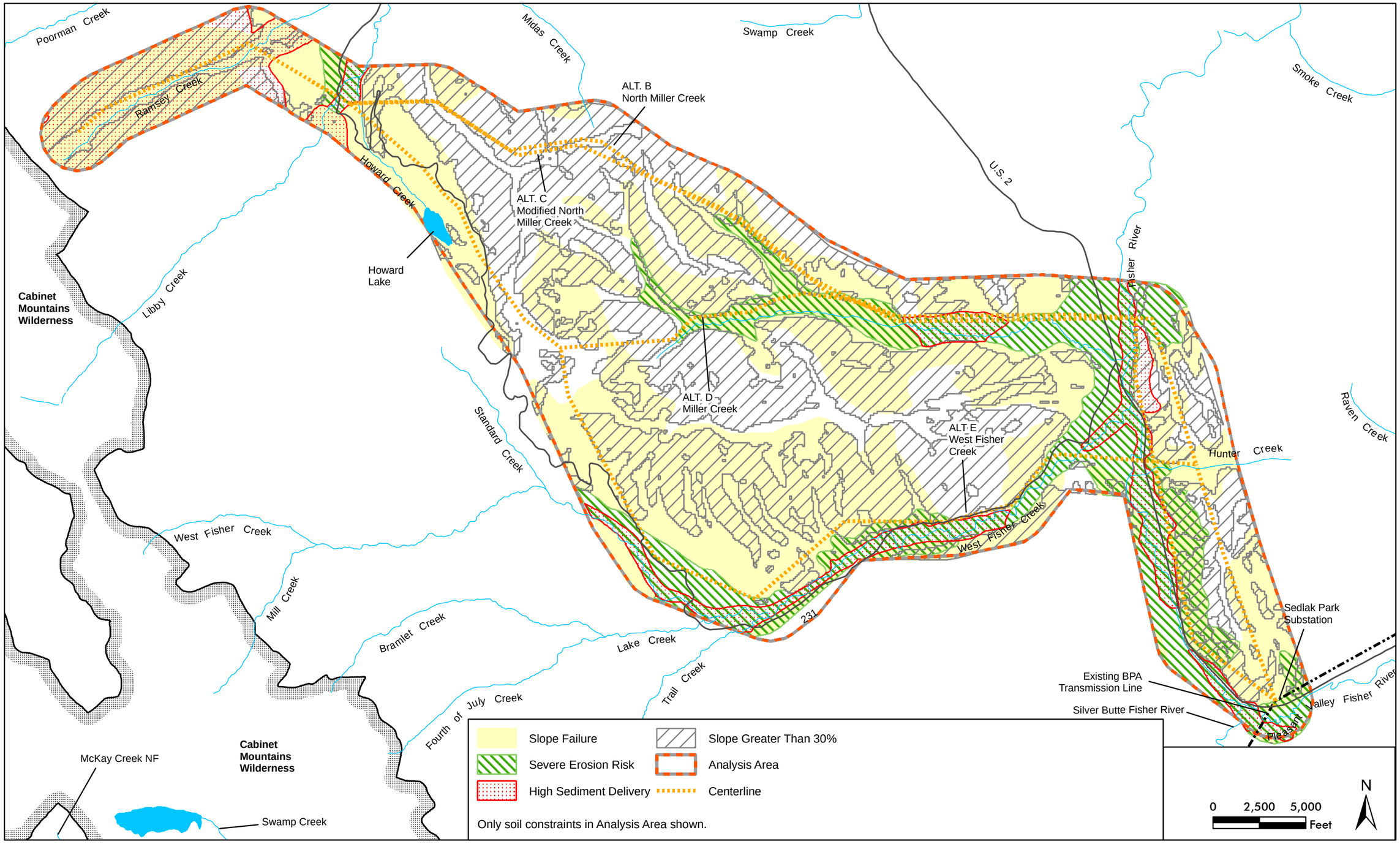


Figure 82. Soil Constraints Along Transmission Line Alternatives

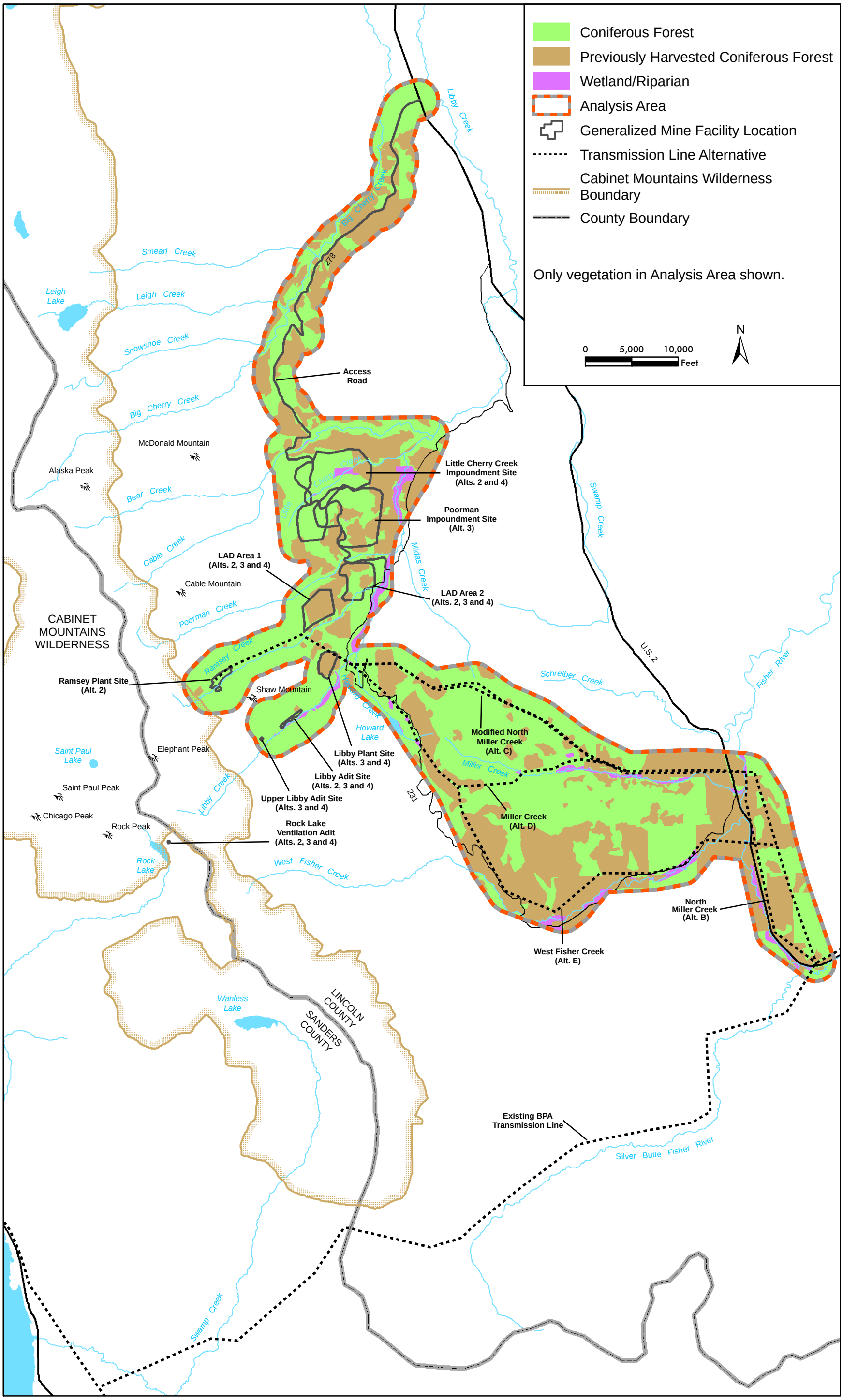


Figure 83. Vegetation Communities in the Analysis Area

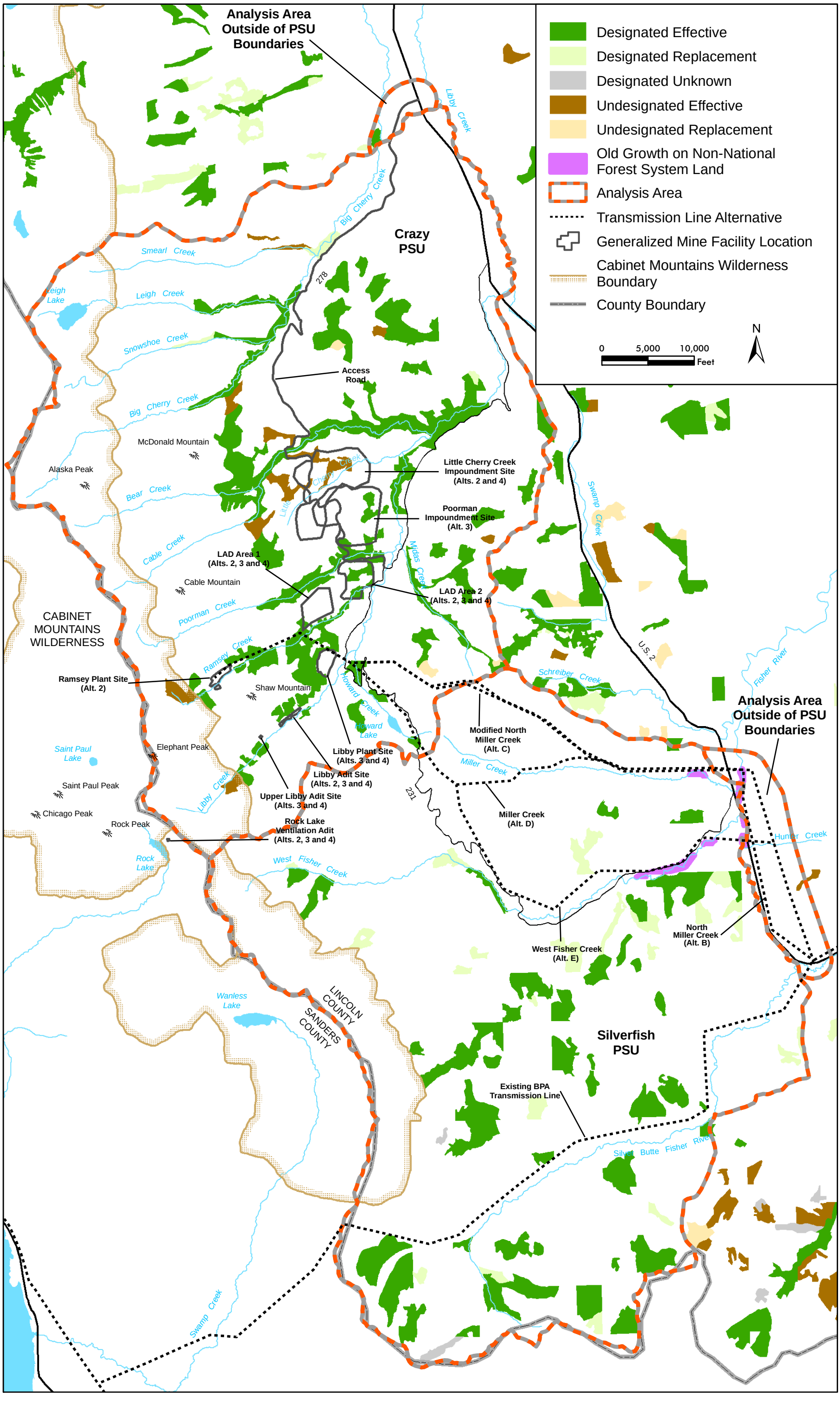


Figure 84. Old Growth Forest in the Analysis Area

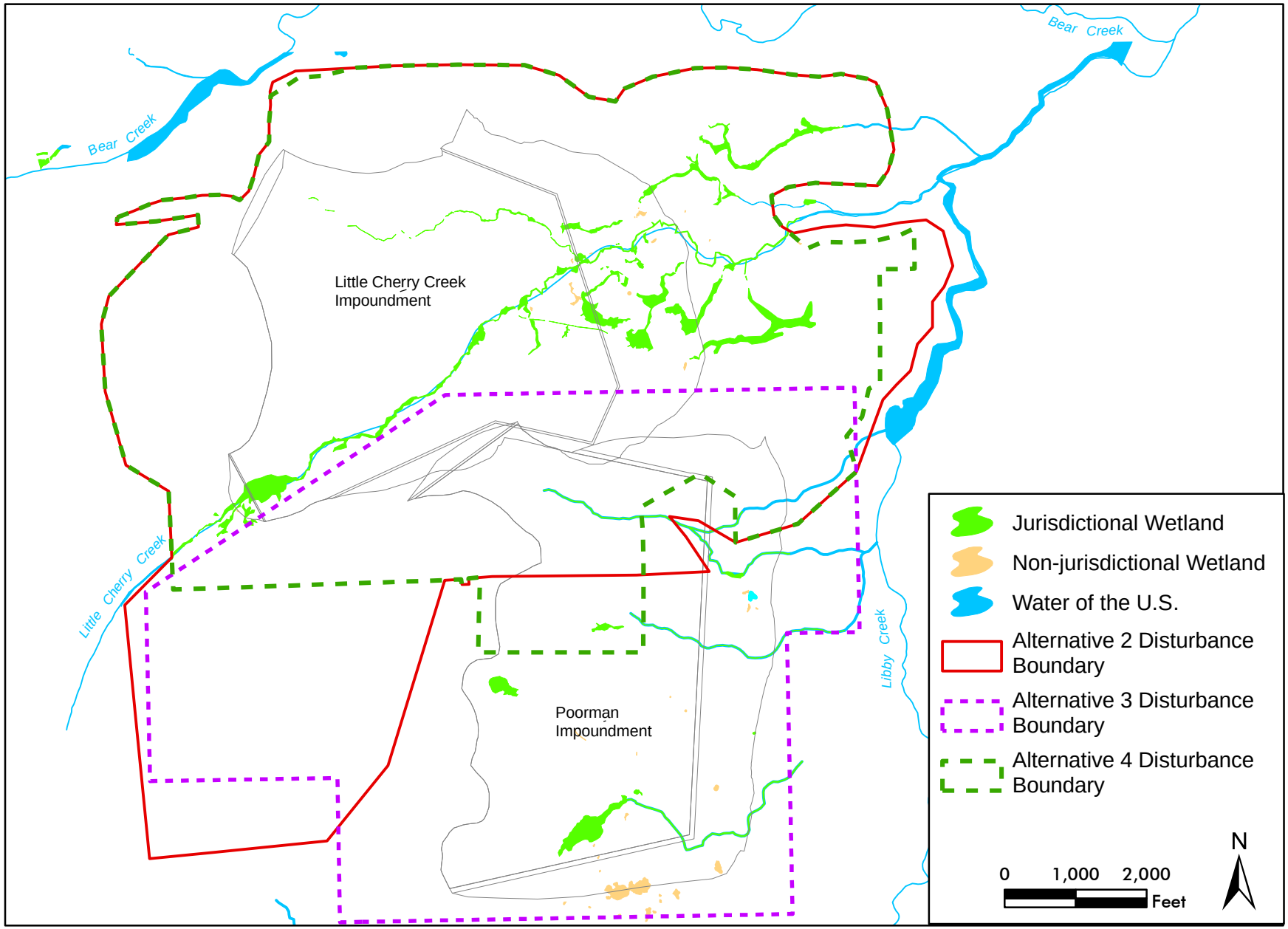


Figure 85. Wetlands in the Two Tailings Impoundment Sites

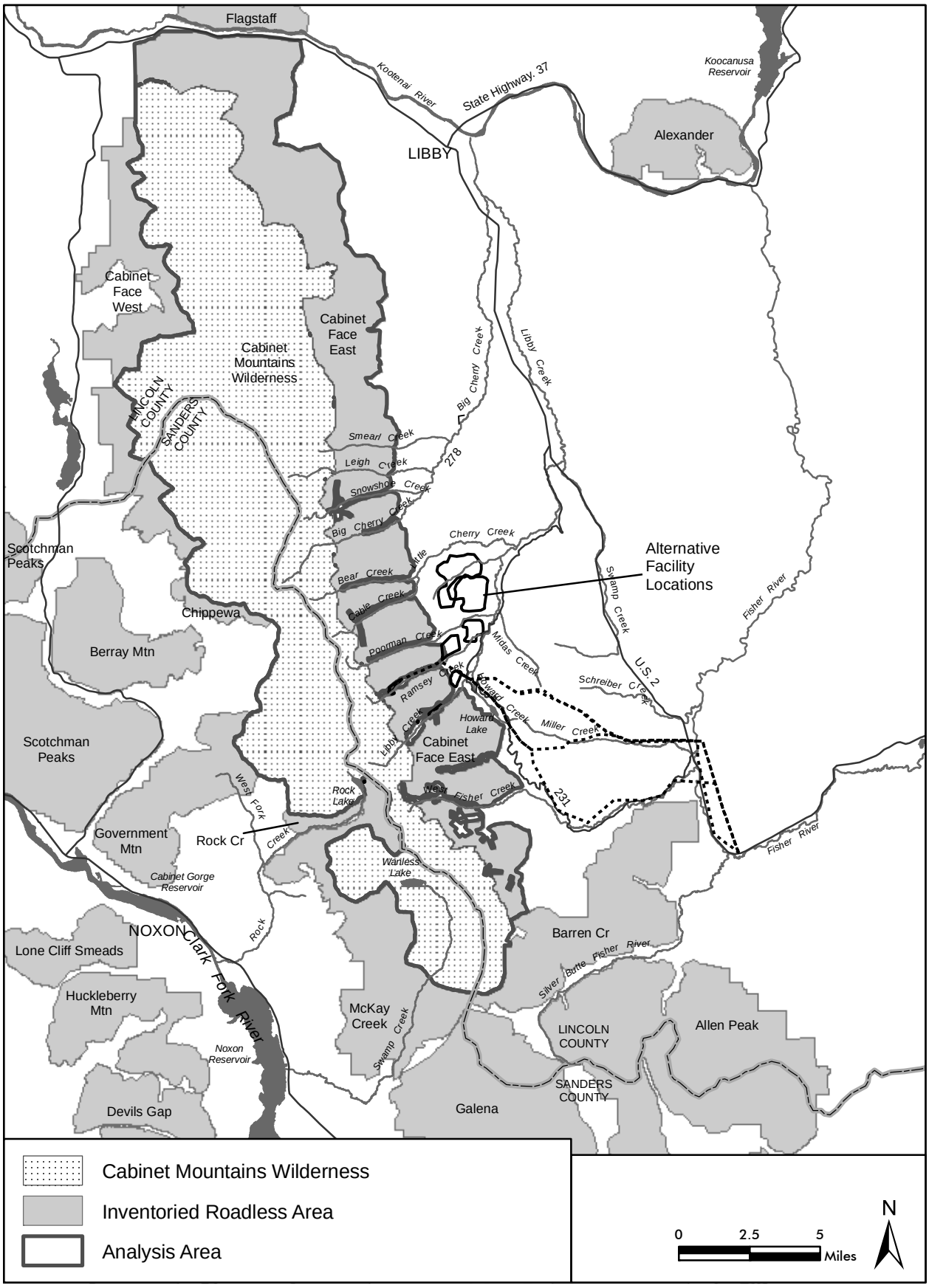


Figure 86. Cabinet Mountains Wilderness and the Cabinet Face East IRA

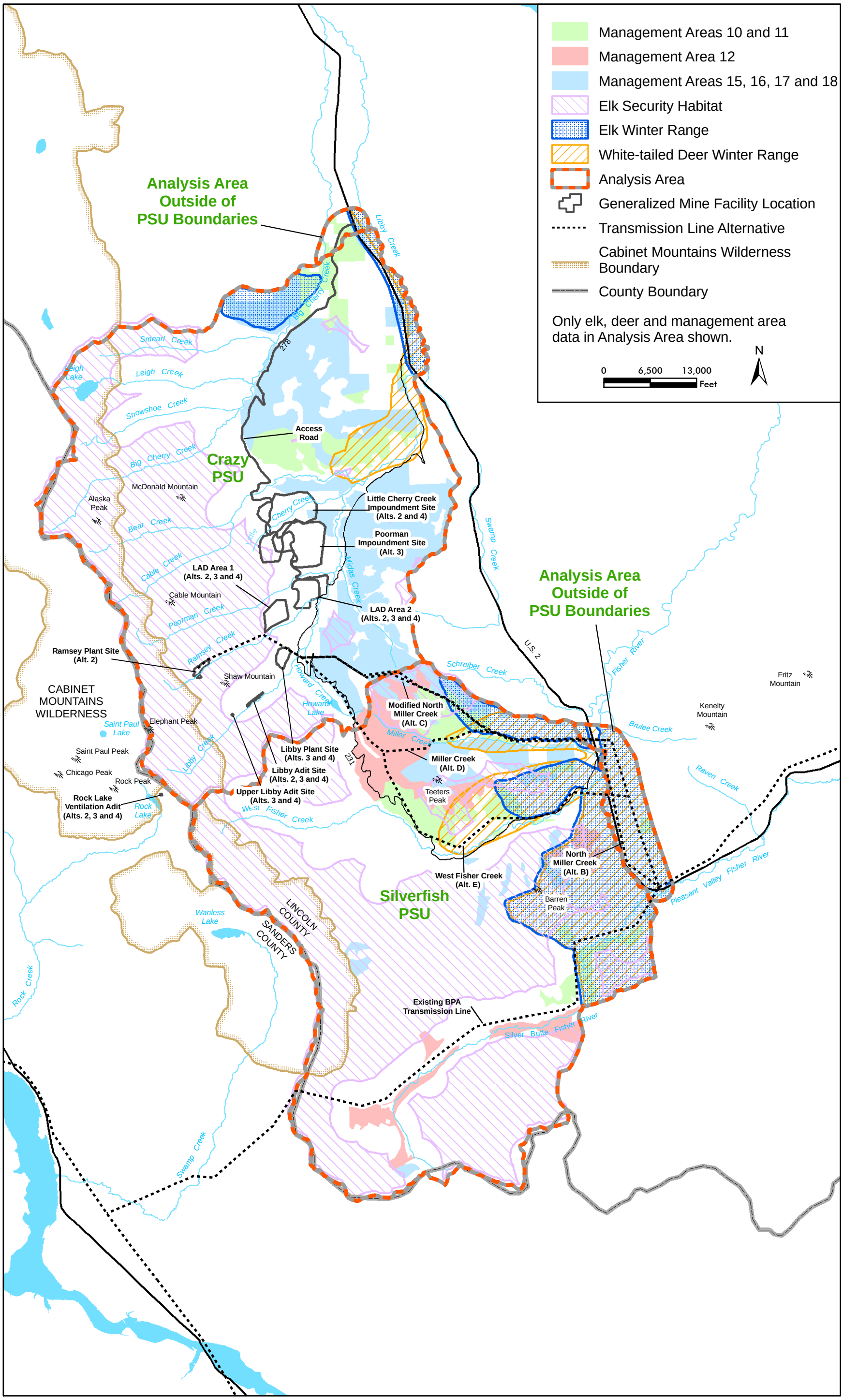


Figure 87. Elk and White-tailed Deer Habitat in the Analysis Area

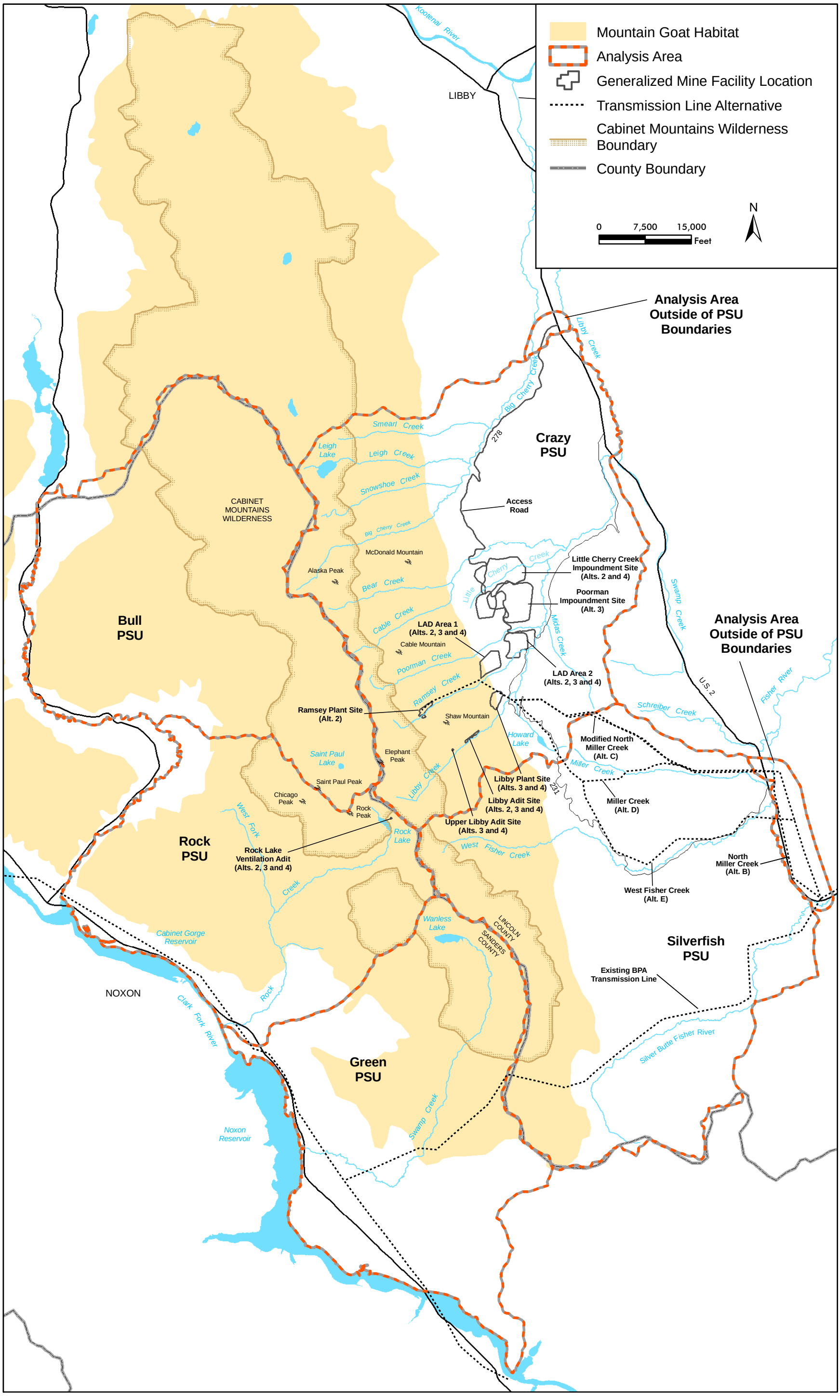


Figure 88. Mountain Goat Habitat in the Analysis Area

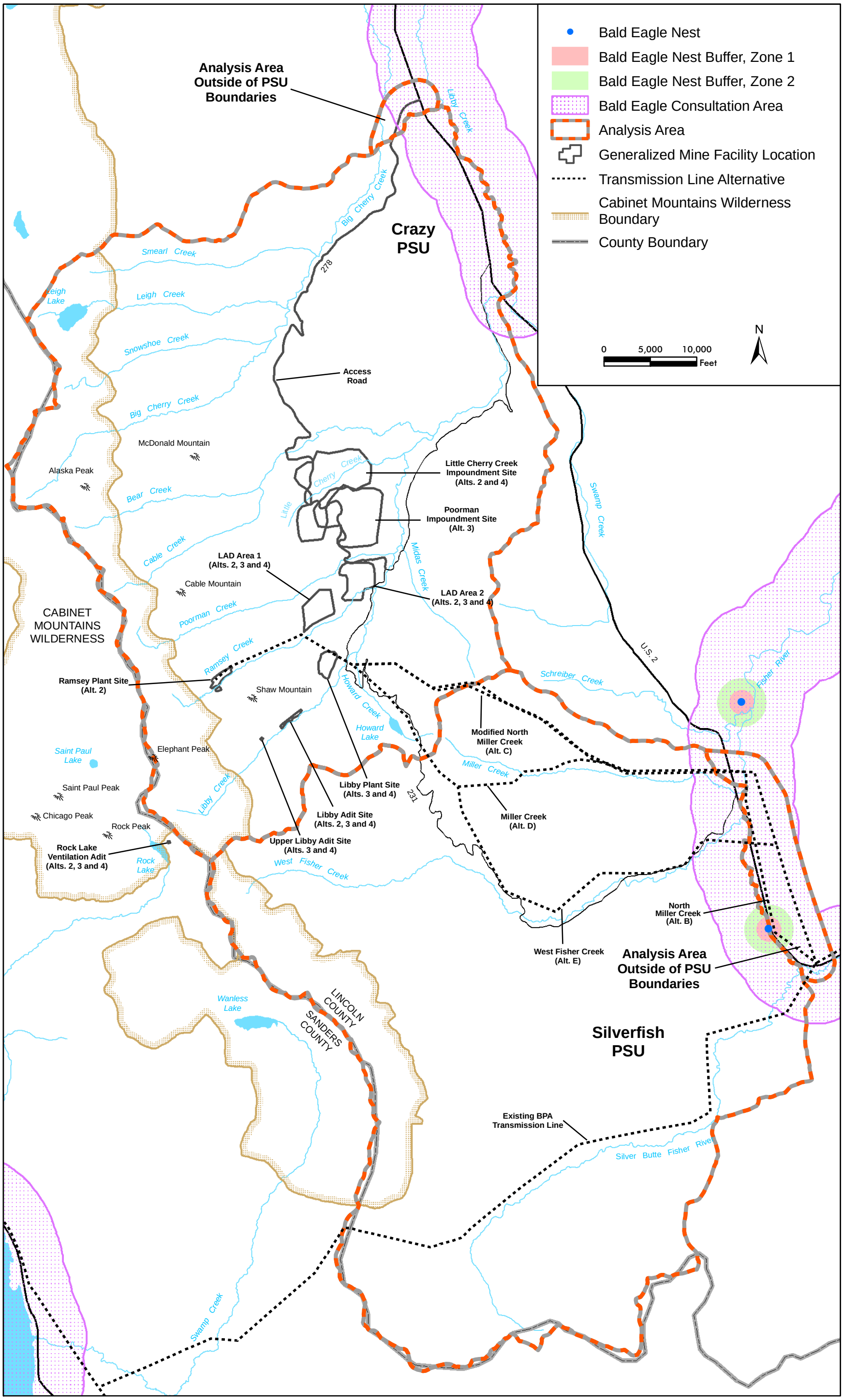


Figure 89. Bald Eagle Habitat Potentially Affected in the Analysis Area

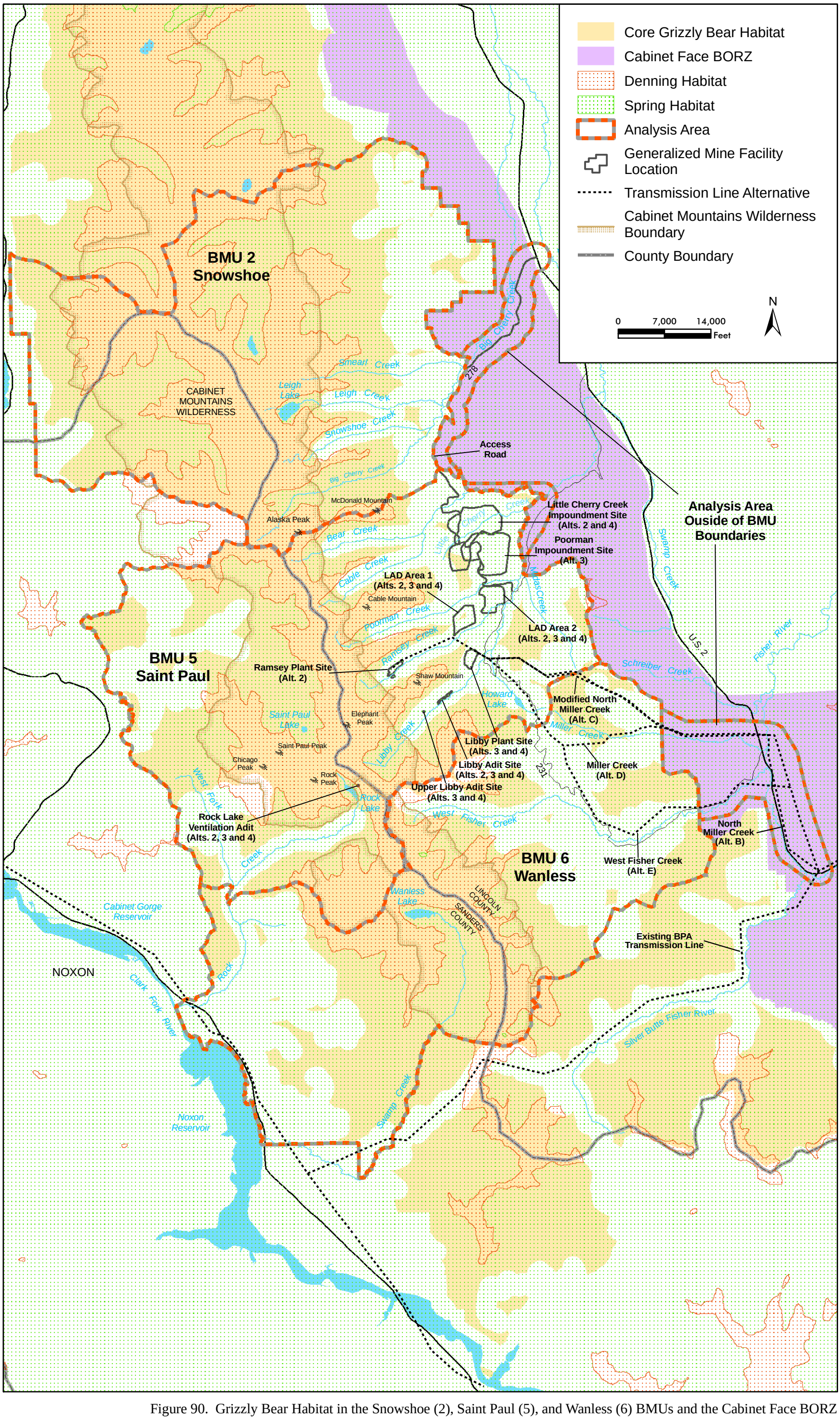


Figure 90. Grizzly Bear Habitat in the Snowshoe (2), Saint Paul (5), and Wanless (6) BMUs and the Cabinet Face BORZ

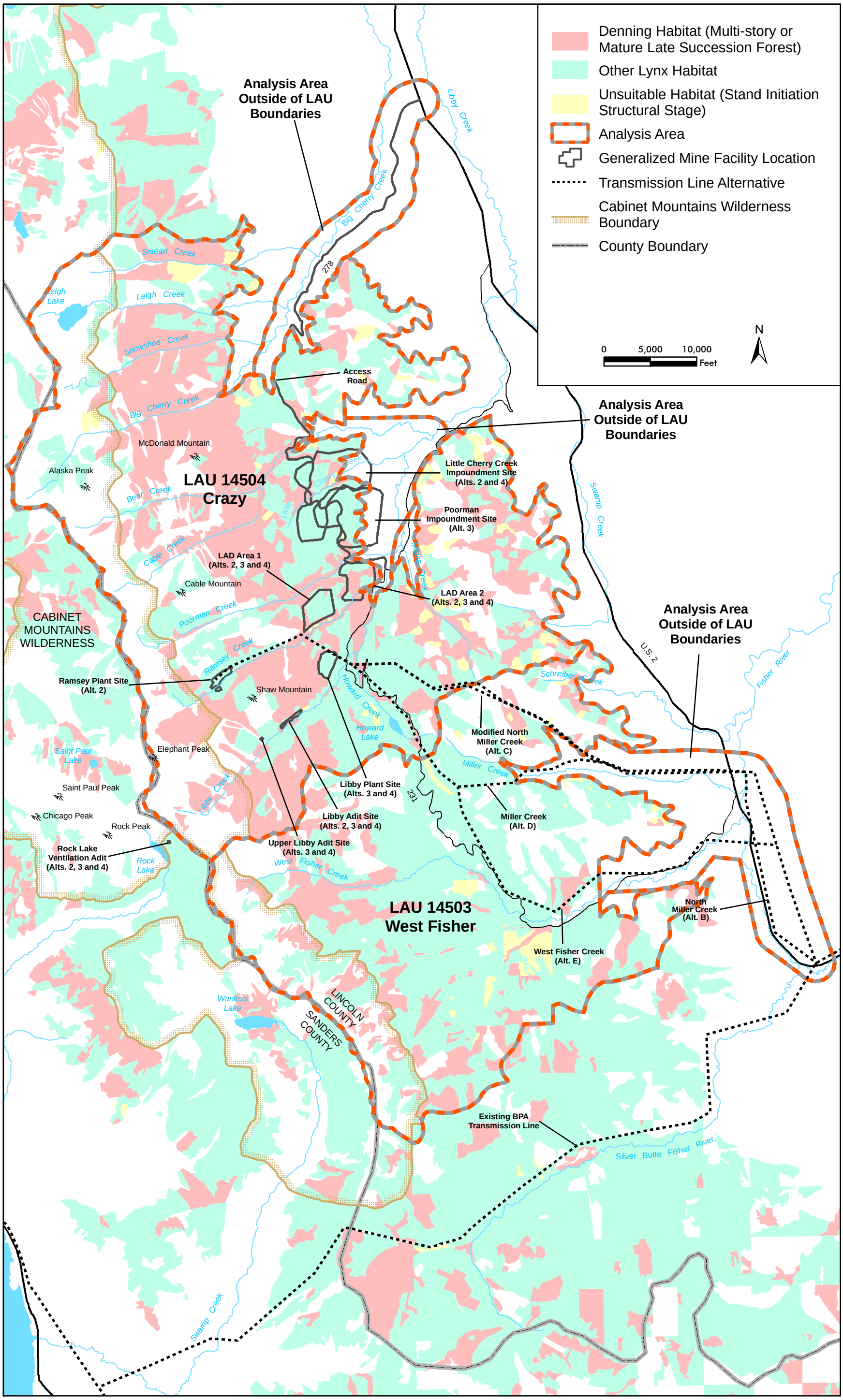


Figure 91. Lynx Habitat in the Analysis Area

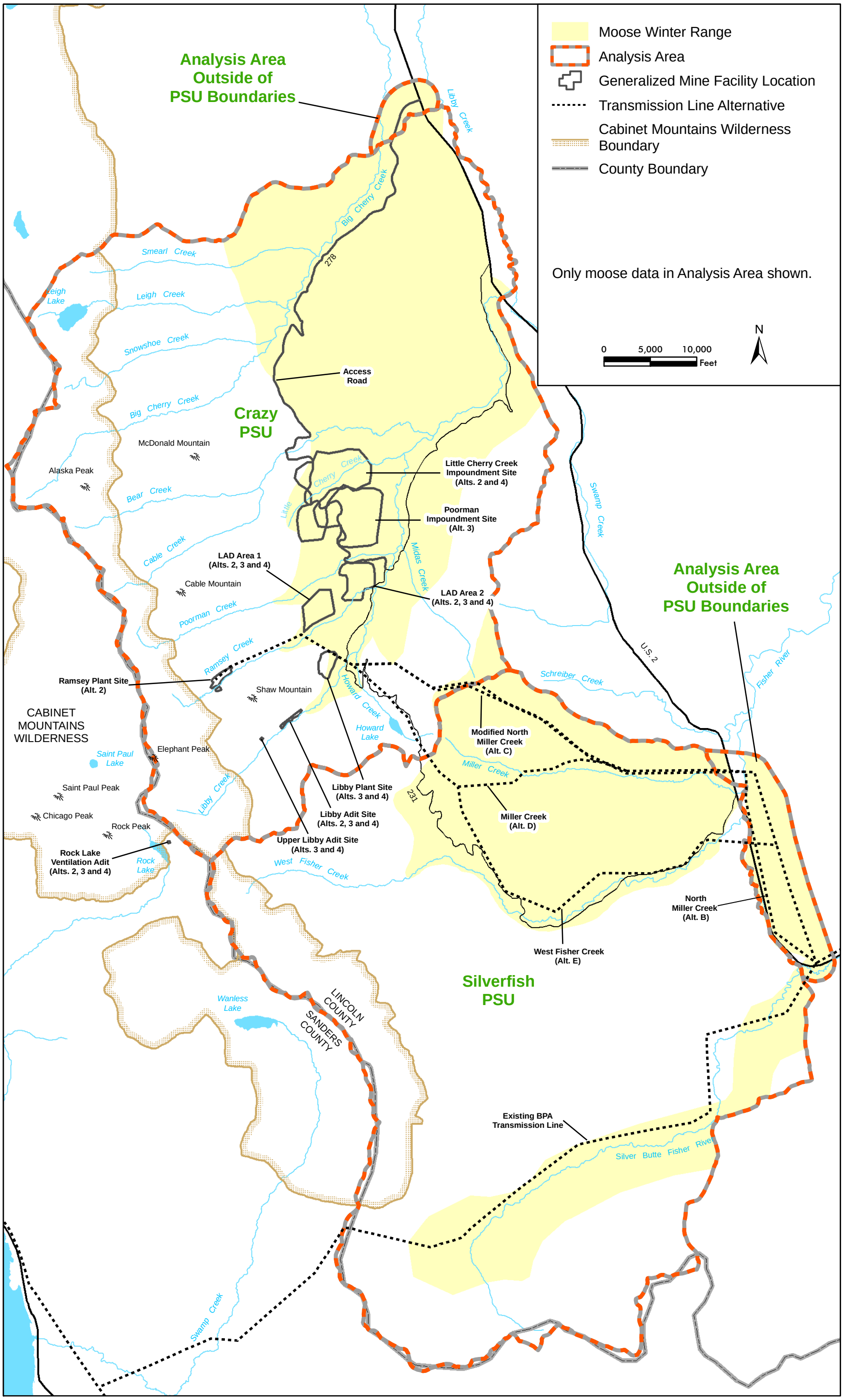


Figure 92. Moose Habitat in the Analysis Area

Appendix A—1993 Board of Health and Environmental Sciences Order

BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES
OF THE STATE OF MONTANA

In the Matter of the Petition for Modification of Quality of Ambient Waters Submitted by Noranda Minerals Corporation for the Montanore Project	)	Docket No. BHES-93-001-WQB

FINAL DECISION AND STATEMENT OF REASONS

BACKGROUND

1. The Montanore Project, a proposed underground copper and silver mine located in northwestern Montana, is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. The proposed project includes the development of a mine in Sanders County and the construction of a mill and associated mine waste disposal facilities in Lincoln County, 18 miles south of Libby, Montana.

2. On December 13, 1989, Noranda filed a petition for Change in Quality of Ambient Waters with the Montana Board of Health and Environmental Sciences (Board) for the proposed Montanore Project. Supplemental Information in Support of the Petition was submitted in May 1992. (The December 13, 1989 petition and the supplement submitted in May 1992 are hereinafter referred to as "Petition").

3. The Petition to allow lower water quality was submitted by Noranda because ". . . the proposed mining and milling operation cannot be designed without the expected occurrence of excess water from precipitation and mine flow." (December 13, 1989 Petition).

4. On November 20, 1992, the Board held a public hearing on

the petition to lower the quality of waters impacted by Noranda's proposed Montanore Project pursuant to ARM 16.20.705. The Board considered oral and written testimony offered prior to and at the hearing, the Petition, and the final environmental impact statement (FEIS) prepared for the proposed project by the Montana Department of Health and Environmental Sciences (Department), the Montana Department of Natural Resources and Conservation, the U.S. Forest Service, and the Montana Department of State Lands.

5. Noranda's proposed method of mine water discharge would lower the water quality for certain parameters in the surface and groundwater where the ambient quality for those parameters is higher than the applicable water quality standards. The ambient concentrations, Noranda's requested changes from ambient concentrations, and the Montana Water Quality Standards are shown in Table 1.

Table 1

Ambient quality, requested concentrations, and the Montana Water Quality Standards. All units are in mg/l.

	Existing Water Quality[a]	Noranda Requested Concentration[b]	Applicable Standard[c]
Surface Water			
Chromium	<0.02	0.005	0.011
Copper	0.002	0.003	0.003
Iron	0.08	0.1	0.3
Manganese	<0.02	0.05	0.05
Zinc	0.02	0.025	0.0271
NO3 + NO2 as N	0.13	5.5[e]	10[d]
Ammonia, Total	0.08	1.5	2.2
Tot. Diss. Solids	29	100.0	250
Groundwater			
Chromium	<0.02	0.02	0.05
Copper	<0.02	0.1	1
Iron	<0.19	0.2	0.3
Manganese	<0.45	0.05	0.05
Zinc	<0.06	0.1	5
NO3 + NO2 as N	0.36	10	10
Ammonia, Total	--	--	--
Tot. Diss. Solids	108	200	500

[a] Surface water values are based on data for Libby, Ramsey and Poorman creek given in tables 3-14 in the FEIS. Ground water values are based on data for wells in the adit, land application and tailing pond areas given in table 3-18 in the FEIS.

[b] Based on table 2-1(R) in the May 1992 Supplement to the petition.

[c] Except for nitrate these are based on the lowest applicable standard.

[d] The 10 mg/l standard is to protect public health; however, the highest allowable level which will not cause undesirable aquatic life is 1 mg/l [ARM 16.20.633 (1)(e)].

[e] Noranda changed their request to 1.0 mg/l at the Hearing

6. Pursuant to ARM 16.20.705(6), the Board's final decision on a petition to allow degradation must be accompanied by a statement of reasons stating the basis for the decision and explaining why degradation is or is not justified.

FINAL DECISION AND ORDER

The petition of Noranda to lower water quality in the groundwater and surface water adjacent to the proposed Montanore Project is granted with the following conditions:

(1) Petitioner shall provide secondary treatment or equivalent as required by ARM 16.20.631(3). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen, will satisfy this requirement. In addition, this treatment will also satisfy the requirements of ARM 16.20.631(3) with regard to metals. Accordingly, the Department shall review Petitioner's design criteria and final engineering plans to determine that at least 80% removal of nitrogen shall be achieved.

(2) Design criteria and final engineering plans and specifications shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to any activities that would cause degradation of surface or ground water.

(3) In determining allowable changes in nitrate concentration in receiving waters, the Board bases its decision on the site

specific facts of each case, taking into account the protection of beneficial uses.

In this case, the Board finds, based on the evidence presented, that the Department's recommended limit of 1.0 mg/l inorganic nitrogen in surface water should not be exceeded. The petition is therefore granted with the Department's recommended limit of 1.0 mg/l for total inorganic nitrogen in surface waters. The requested limit of 10.0 mg/l in ground water is granted subject to the following conditions. The concentration of total inorganic nitrogen in the ground water shall not exceed levels reflecting less than 80% removal by the treatment process and shall not cause exceedences of 1.0 mg/l total inorganic nitrogen in Libby, Ramsey or Poorman Creeks.

Surface and ground water monitoring, including biological monitoring, as determined necessary by the Department, will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired.

(4) The Board adopts into this Order the modifications developed in Alternative 3, Option C, of the Final EIS, addressing surface and ground water monitoring, fish tissue analysis and instream biological monitoring. Monitoring plans shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to the commencement of any activity that would cause degradation of surface or ground water in the project area. The monitoring plan shall contain a

system of surface and ground water monitoring locations sufficient to determine compliance with this Order.

(5) Changes from ambient quality requested in the Petition for constituents, other than those containing nitrogen, will not, after treatment as specified in paragraph 1 of this Order, adversely affect beneficial uses and are therefore granted.

(6) Based on the evidence presented at the hearing, the Board has determined that Petitioner has affirmatively demonstrated that the changes granted herein are justifiable as the result of necessary social or economic development.

(7) Noranda shall provide annual funding to the department so that the department can perform sufficient independent monitoring to verify the monitoring performed by the company. Such funding shall not exceed the actual cost of such monitoring and in no case may it exceed $35,000 annually (in 1992 dollars).

(8) The provisions of this Order are applicable to surface and ground water affected by the Montanore Mine Project located in Sanders and Lincoln County, Montana, and shall remain in effect during the operational life of this mine and for so long thereafter as necessary.

STATEMENT OF REASONS

The Board's reasons for allowing a change in the ambient quality of waters impacted by the proposed Montanore Mining Project are as follows:

1. Under Section 75-5-303(1), MCA, of the Montana Water

Quality Act, the Board may authorize lower water quality if a demonstration is made that degradation is justified due to necessary economic or social development. If degradation is authorized, the Board must ensure that existing and anticipated uses are fully protected.

2. Section 75-5-303(2), MCA, requires ". . . the degree of waste treatment necessary to maintain that existing high water quality." Section 75-5-304, MCA, and ARM 16.20.631 require treatment and standards of performance for activities that may impair water quality. In particular, ARM 16.20.631(3) requires that industrial wastes, at minimum, must be treated using technology that is the best practicable control technology available (BPCTCA), or, if BPCTCA has not been determined by EPA, then the equivalent of secondary treatment as determined by the Department. If it has been demonstrated that there are no economically and technologically reasonable methods of treatment or practices that would result in no degradation, then the Board will determine whether lower water quality is justified due to necessary economic or social development. As part of this determination, the Board must require as a prerequisite BPCTCA (or if BPCTCA has not been determined by EPA, the equivalent of secondary treatment as determined by the Department). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen shall be achieved, will satisfy the requirements of ARM 16.20.631(3) with regard to nitrogen and metals.

3. Application of treatment as discussed in the Petition would maintain existing water quality except for possible increases in nitrate, chromium, copper, iron, manganese, zinc, total dissolved solids (TDS), and ammonia. The requested increases would not adversely affect any beneficial uses except for the increase in nitrate. The effects of nitrate increases on beneficial uses are discussed below.

4. The proposal for mine wastewater disposal submitted by Noranda relies on a tailing impoundment, collection systems, and land treatment for wastewater disposal. Monitoring would be required to ensure that allowed levels of nitrate and other compounds would not be exceeded. This proposal would result in lower ambient water quality for all of the parameters that are the subject of this Petition.

5. The preferred alternative identified in the FEIS discusses land treatment prior to disposal. Water treated by the methods discussed under this alternative would substantially reduce the amounts of inorganic nitrogen in the surface and groundwater.

The testimony submitted at the hearing further confirms that land application is an appropriate treatment methodology for nitrogen reduction.

Because the land treatment proposed by Noranda would reduce suspended solids and metal concentrations on a year-round basis, the resulting concentrations of metals after dilution would not impair existing uses in these waters.

6. Published studies indicate that very low levels of

nutrients may stimulate algal growth, but that these studies have added both nitrogen and phosphorus (a situation not strictly applicable here since phosphorus would not be added in this case) and that to protect against the development of undesirable growth in streams and rivers, the Department believes inorganic nitrogen should not exceed 1.0 mg/l.

The Board, based upon the evidence submitted by the Department and by Petitioner, accepts 1.0 mg/l as the maximum allowable concentration of inorganic nitrogen in Libby, Ramsey and Poorman Creeks, for protection of all beneficial uses.

7. The analysis of land treatment in the FEIS demonstrates that this treatment (secondary treatment as defined by the Department), would achieve compliance with the allowable concentration of 1.0 mg/l of inorganic nitrogen in surface water. At the Hearing, Noranda changed its request from 5.5 mg/l of nitrate to 1.0 mg/l total soluble inorganic nitrogen. This level should adequately protect existing beneficial uses. However, biological monitoring is necessary to insure protection of beneficial uses and to assure compliance with ARM 16.20.633(1)(e), as well as other applicable standards.

8. Beneficial uses of the groundwater would not be impaired if a nitrate concentration of 10 mg/l was allowed, as requested in the petition. However, concentration of inorganic nitrogen in ground water at this level may cause violations of the standards imposed by the Board. Therefore, allowable amounts of inorganic nitrogen in ground water will be governed by the land application

treatment requirements and the surface water limits imposed by the Board.

9. Concerns were raised at the hearing regarding the ability of the Department to fund the cost of State-conducted monitoring at the Montanore Project to ensure compliance with limitations imposed by the Board in granting the Petition.

10. An analysis of the necessary economic or social development associated with the proposed project has been submitted by Noranda in its Petition and further discussed in the EIS. Further testimony was submitted by the Petitioner at the hearing regarding the importance of the Montanore Project for economic or social development in Lincoln and Sanders County. The need for the proposed project is to develop a source of copper and silver for the production of world wide commodities. Information presented to the Board indicates that the construction and operation of the Montanore Project will have beneficial economic and social impacts in Lincoln and Sanders Counties during the 18 years of its operation. Increased direct and indirect employment and increases in local government revenues associated with the mining project will benefit the impacted area. In addition, the lower water quality associated with the proposed development will be negligible.

For the reasons stated above, the Board finds that degradation resulting from the Montanore Mining Project is justified.

Dated this 20 day of November, 1992.

Raymond W. Gustafson

RAYMOND W. GUSTAFSON, CHAIRMAN, BOARD
OF HEALTH AND ENVIRONMENTAL SCIENCES

Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternatives

BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES
OF THE STATE OF MONTANA

In the Matter of the Petition for Modification of Quality of Ambient Waters Submitted by Noranda Minerals Corporation for the Montanore Project	)	Docket No. BHES-93-001-WQB

FINAL DECISION AND STATEMENT OF REASONS

BACKGROUND

1. The Montanore Project, a proposed underground copper and silver mine located in northwestern Montana, is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. The proposed project includes the development of a mine in Sanders County and the construction of a mill and associated mine waste disposal facilities in Lincoln County, 18 miles south of Libby, Montana.

2. On December 13, 1989, Noranda filed a petition for Change in Quality of Ambient Waters with the Montana Board of Health and Environmental Sciences (Board) for the proposed Montanore Project. Supplemental Information in Support of the Petition was submitted in May 1992. (The December 13, 1989 petition and the supplement submitted in May 1992 are hereinafter referred to as "Petition").

3. The Petition to allow lower water quality was submitted by Noranda because ". . . the proposed mining and milling operation cannot be designed without the expected occurrence of excess water from precipitation and mine flow." (December 13, 1989 Petition).

4. On November 20, 1992, the Board held a public hearing on

the petition to lower the quality of waters impacted by Noranda's proposed Montanore Project pursuant to ARM 16.20.705. The Board considered oral and written testimony offered prior to and at the hearing, the Petition, and the final environmental impact statement (FEIS) prepared for the proposed project by the Montana Department of Health and Environmental Sciences (Department), the Montana Department of Natural Resources and Conservation, the U.S. Forest Service, and the Montana Department of State Lands.

5. Noranda's proposed method of mine water discharge would lower the water quality for certain parameters in the surface and groundwater where the ambient quality for those parameters is higher than the applicable water quality standards. The ambient concentrations, Noranda's requested changes from ambient concentrations, and the Montana Water Quality Standards are shown in Table 1.

Table 1

Ambient quality, requested concentrations, and the Montana Water Quality Standards. All units are in mg/l.

	Existing Water Quality[a]	Noranda Requested Concentration[b]	Applicable Standard[c]
Surface Water			
Chromium	<0.02	0.005	0.011
Copper	0.002	0.003	0.003
Iron	0.08	0.1	0.3
Manganese	<0.02	0.05	0.05
Zinc	0.02	0.025	0.0271
NO3 + NO2 as N	0.13	5.5[e]	10[d]
Ammonia, Total	0.08	1.5	2.2
Tot. Diss. Solids	29	100.0	250
Groundwater			
Chromium	<0.02	0.02	0.05
Copper	<0.02	0.1	1
Iron	<0.19	0.2	0.3
Manganese	<0.45	0.05	0.05
Zinc	<0.06	0.1	5
NO3 + NO2 as N	0.36	10	10
Ammonia, Total	--	--	--
Tot. Diss. Solids	108	200	500

[a] Surface water values are based on data for Libby, Ramsey and Poorman creek given in tables 3-14 in the FEIS. Ground water values are based on data for wells in the adit, land application and tailing pond areas given in table 3-18 in the FEIS.

[b] Based on table 2-1(R) in the May 1992 Supplement to the petition.

[c] Except for nitrate these are based on the lowest applicable standard.

[d] The 10 mg/l standard is to protect public health; however, the highest allowable level which will not cause undesirable aquatic life is 1 mg/l [ARM 16.20.633 (1)(e)].

[e] Noranda changed their request to 1.0 mg/l at the Hearing

6. Pursuant to ARM 16.20.705(6), the Board's final decision on a petition to allow degradation must be accompanied by a statement of reasons stating the basis for the decision and explaining why degradation is or is not justified.

FINAL DECISION AND ORDER

The petition of Noranda to lower water quality in the groundwater and surface water adjacent to the proposed Montanore Project is granted with the following conditions:

(1) Petitioner shall provide secondary treatment or equivalent as required by ARM 16.20.631(3). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen, will satisfy this requirement. In addition, this treatment will also satisfy the requirements of ARM 16.20.631(3) with regard to metals. Accordingly, the Department shall review Petitioner's design criteria and final engineering plans to determine that at least 80% removal of nitrogen shall be achieved.

(2) Design criteria and final engineering plans and specifications shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to any activities that would cause degradation of surface or ground water.

(3) In determining allowable changes in nitrate concentration in receiving waters, the Board bases its decision on the site

specific facts of each case, taking into account the protection of beneficial uses.

In this case, the Board finds, based on the evidence presented, that the Department's recommended limit of 1.0 mg/l inorganic nitrogen in surface water should not be exceeded. The petition is therefore granted with the Department's recommended limit of 1.0 mg/l for total inorganic nitrogen in surface waters. The requested limit of 10.0 mg/l in ground water is granted subject to the following conditions. The concentration of total inorganic nitrogen in the ground water shall not exceed levels reflecting less than 80% removal by the treatment process and shall not cause exceedences of 1.0 mg/l total inorganic nitrogen in Libby, Ramsey or Poorman Creeks.

Surface and ground water monitoring, including biological monitoring, as determined necessary by the Department, will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired.

(4) The Board adopts into this Order the modifications developed in Alternative 3, Option C, of the Final EIS, addressing surface and ground water monitoring, fish tissue analysis and instream biological monitoring. Monitoring plans shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to the commencement of any activity that would cause degradation of surface or ground water in the project area. The monitoring plan shall contain a

system of surface and ground water monitoring locations sufficient to determine compliance with this Order.

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(6) Based on the evidence presented at the hearing, the Board has determined that Petitioner has affirmatively demonstrated that the changes granted herein are justifiable as the result of necessary social or economic development.

(7) Noranda shall provide annual funding to the department so that the department can perform sufficient independent monitoring to verify the monitoring performed by the company. Such funding shall not exceed the actual cost of such monitoring and in no case may it exceed $35,000 annually (in 1992 dollars).

(8) The provisions of this Order are applicable to surface and ground water affected by the Montanore Mine Project located in Sanders and Lincoln County, Montana, and shall remain in effect during the operational life of this mine and for so long thereafter as necessary.

STATEMENT OF REASONS

The Board's reasons for allowing a change in the ambient quality of waters impacted by the proposed Montanore Mining Project are as follows:

1. Under Section 75-5-303(1), MCA, of the Montana Water

Quality Act, the Board may authorize lower water quality if a demonstration is made that degradation is justified due to necessary economic or social development. If degradation is authorized, the Board must ensure that existing and anticipated uses are fully protected.

2. Section 75-5-303(2), MCA, requires ". . . the degree of waste treatment necessary to maintain that existing high water quality." Section 75-5-304, MCA, and ARM 16.20.631 require treatment and standards of performance for activities that may impair water quality. In particular, ARM 16.20.631(3) requires that industrial wastes, at minimum, must be treated using technology that is the best practicable control technology available (BPCTCA), or, if BPCTCA has not been determined by EPA, then the equivalent of secondary treatment as determined by the Department. If it has been demonstrated that there are no economically and technologically reasonable methods of treatment or practices that would result in no degradation, then the Board will determine whether lower water quality is justified due to necessary economic or social development. As part of this determination, the Board must require as a prerequisite BPCTCA (or if BPCTCA has not been determined by EPA, the equivalent of secondary treatment as determined by the Department). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen shall be achieved, will satisfy the requirements of ARM 16.20.631(3) with regard to nitrogen and metals.

3. Application of treatment as discussed in the Petition would maintain existing water quality except for possible increases in nitrate, chromium, copper, iron, manganese, zinc, total dissolved solids (TDS), and ammonia. The requested increases would not adversely affect any beneficial uses except for the increase in nitrate. The effects of nitrate increases on beneficial uses are discussed below.

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5. The preferred alternative identified in the FEIS discusses land treatment prior to disposal. Water treated by the methods discussed under this alternative would substantially reduce the amounts of inorganic nitrogen in the surface and groundwater.

The testimony submitted at the hearing further confirms that land application is an appropriate treatment methodology for nitrogen reduction.

Because the land treatment proposed by Noranda would reduce suspended solids and metal concentrations on a year-round basis, the resulting concentrations of metals after dilution would not impair existing uses in these waters.

6. Published studies indicate that very low levels of

nutrients may stimulate algal growth, but that these studies have added both nitrogen and phosphorus (a situation not strictly applicable here since phosphorus would not be added in this case) and that to protect against the development of undesirable growth in streams and rivers, the Department believes inorganic nitrogen should not exceed 1.0 mg/l.

The Board, based upon the evidence submitted by the Department and by Petitioner, accepts 1.0 mg/l as the maximum allowable concentration of inorganic nitrogen in Libby, Ramsey and Poorman Creeks, for protection of all beneficial uses.

7. The analysis of land treatment in the FEIS demonstrates that this treatment (secondary treatment as defined by the Department), would achieve compliance with the allowable concentration of 1.0 mg/l of inorganic nitrogen in surface water. At the Hearing, Noranda changed its request from 5.5 mg/l of nitrate to 1.0 mg/l total soluble inorganic nitrogen. This level should adequately protect existing beneficial uses. However, biological monitoring is necessary to insure protection of beneficial uses and to assure compliance with ARM 16.20.633(1)(e), as well as other applicable standards.

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treatment requirements and the surface water limits imposed by the Board.

9. Concerns were raised at the hearing regarding the ability of the Department to fund the cost of State-conducted monitoring at the Montanore Project to ensure compliance with limitations imposed by the Board in granting the Petition.

10. An analysis of the necessary economic or social development associated with the proposed project has been submitted by Noranda in its Petition and further discussed in the EIS. Further testimony was submitted by the Petitioner at the hearing regarding the importance of the Montanore Project for economic or social development in Lincoln and Sanders County. The need for the proposed project is to develop a source of copper and silver for the production of world wide commodities. Information presented to the Board indicates that the construction and operation of the Montanore Project will have beneficial economic and social impacts in Lincoln and Sanders Counties during the 18 years of its operation. Increased direct and indirect employment and increases in local government revenues associated with the mining project will benefit the impacted area. In addition, the lower water quality associated with the proposed development will be negligible.

For the reasons stated above, the Board finds that degradation resulting from the Montanore Mining Project is justified.

Dated this 20 day of November, 1992.

Raymond W. Gustafson

RAYMOND W. GUSTAFSON, CHAIRMAN, BOARD
OF HEALTH AND ENVIRONMENTAL SCIENCES

Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternative

Road Number	Road Name	IGBC Code	INFRA Code
1408	Libby Creek Bottom	1	99
14403	Lower Ramsey	3	09
14404	Bare Road	3	05
14405	Bear Road	3	05
14442	Lampton Pond	4	02
14458	Midasize	4	OPEN
231	Libby Creek Fisher River	4	OPEN
2316	Upper Libby Creek	2	09
2316	Upper Libby Creek	4	OPEN
2317	Poorman Creek	4	09
2317	Poorman Creek	4	OPEN
2317B	Poorman Creek B	3	09
231A	Libby Creek Fisher River A	3	05
231B	Libby Creek Fisher River B	2	05
278	Bear Creek	4	OPEN
278L	Bear Creek L	3	09
278X	Bear Creek X	3	09
385	Miller Creek West Fisher	4	OPEN
4724	South Fork Miller Creek	4	OPEN
4725	N Fork Miller Creek	2	05
4773	Howard Midas Creek	3	09
4773	Howard Midas Creek	4	OPEN
4776A	Horse Mtn Lookout A	4	OPEN
4776B	Horse Mtn Lookout B	4	OPEN
4776C	Horse Mtn Lookout C	2	09
4776F	Horse Mtn Lookout F	2	09
4777	Lower Midas-Howard Lk	3	09
4778	Midas Howard Creek	3	05
4778	Midas Howard Creek	3	OPEN
4778	Midas Howard Creek	4	OPEN
4778C	Midas Howard Creek C	4	OPEN
4778C	Midas Howard Creek C	3	05
4778C	Midas Howard Creek C	3	OPEN
4778E	Midas Howard Creek E	3	OPEN
4778P	Midas Howard Creek P	3	05
4780	Howard Lake-Miller Creek	4	OPEN
4781	Ramsey Creek	2	09
4781	Ramsey Creek	2	OPEN
4781	Ramsey Creek	4	OPEN
4781A	Ramsey Creek A	3	09
4782	Standard Creek-Miller Creek	2	05
4782A	Standard Creek-Miller Creek A	3	05
5003	Cherry Ridge A Extension	3	09
5170	Poorman Creek Unit	4	OPEN
5181	L Cherry Loop H Cowpath	2	09

Translation of IGBC and INFRA codes is available at the KNF.

Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternative

Road Number	Road Name	IGBC Code	INFRA Code
5181A	L Cherry Loop H Cowpath A	2	09
5182	Little Cherry Bear Creek	4	09
5182	Little Cherry Bear Creek	4	OPEN
5183	Little Cherry View	3	09
5184	Bear-Little Cherry	2	09
5184A	Bear-Little Cherry A	2	09
5185	S Bear Little Cherry	2	09
5185A	S Bear Little Cherry A	2	09
5186	Ramsey Creek Bottom	3	09
5187	L Cherry Loop L Clearing	3	09
5192	Midas Bowl	3	OPEN
5192A	Midas Bowl A	3	OPEN
5326	Standard Creek-Miller Creek Oldie	3	05
6200	Granite-Bear Creek	2	09
6200D	Granite-Bear Creek D	2	09
6200E	Granite-Bear Creek E	2	09
6200F	Granite-Bear Creek F	2	09
6201	Cherry Ridge	3	09
6201A	Cherry Ridge A	3	09
6205D	Big Hoodoo D	4	OPEN
6209E	Crazyman E	4	OPEN
6210	Libby Ramsey	2	09
6212	Little Cherry Loop	4	OPEN
6212H	Little Cherry Loop H	2	09
6212L	Little Cherry Loop L	3	09
6212M	Little Cherry Loop M	2	09
6212P	Poorman Pit	2	09
6214	Cable-Poorman Creek	2	09
6214F	Cable-Poorman Creek F	2	09
6701	South Ramsey Creek	2	09
6702	South Libby Cr	1	09
6745	Standard Creek	2	05
6745	Standard Creek	3	05
6745	Standard Creek	4	OPEN
6753	Sedlak Creek	4	OPEN
6787 B	Hoodoo Bear B	4	OPEN
763	Main Fisher River	4	OPEN
8749	Noranda Mine	2	99
8749A	Noranda Mine A	2	99
8770	4W Ranch (Cactus Wade)	4	OPEN
8773	Wade's Back Entry	4	95
8838	L Cherry Ms10377 8838	2	09
8841	L Cherry Ms10377 8841	2	09
99760	Brulee-Hunter 99760	4	OPEN
99760B	Brulee-Hunter 99760B	2	99

Translation of IGBC and INFRA codes is available at the KNF.

Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternative

Road Number	Road Name	IGBC Code	INFRA Code
99760C	Brulee-Hunter 99760C	2	99
99762	Kenelty Jump-Up 99762	4	OPEN
99763	Hunter Creek 99763	4	OPEN
99763B	Hunter Creek 99763B	4	OPEN
99764	Kenelty Mtn 99764	4	OPEN
99765	Sedlak Creek 99765	4	OPEN
99765A	Sedlak Creek 99765A	4	OPEN
99768	Sedlak Creek 99768	4	OPEN
99768A	Sedlak Creek 99768A	4	OPEN
99772	Shelley Jump Up 99772	4	OPEN
99806	Wade-Kenelty 99806	4	95
99806D	Wade-Kenelty D 99806D	2	99
99826	Middle Miller Creek. 99826	4	OPEN
99828	Miller Creek W Fisher 99828	4	OPEN
99830	West Fisher 99830	3	99
99834	Waylett Flat 99834	3	99
99834A	Waylett Flat 99834A	3	99
99844	West Fisher 99844	2	05
99845	West Fisher 99845	2	05
8773	Wade's Back Entry	4	99
99806	Wade-Kenelty 99806	2	99

Translation of IGBC and INFRA codes is available at the KNF.

Appendix C— Surface Water, Ground Water, and Aquatic Life Monitoring Plans, Alternatives 3 and 4

1.0 Water Resources Monitoring Plan

MMC proposes to construct an underground mine that would require the construction of several associated features, such as a tailings impoundment and one or more LAD Areas for disposal of water. The mine and adits, tailings impoundment, and LAD Areas have the potential to affect surface and ground water quality and quantity in the area. The objective of the surface and ground water monitoring program is to establish pre-construction conditions, and then periodically monitor those conditions as the facilities are constructed and operated. Water resources monitoring goals would be to quantify any measurable environmental impacts accompanying construction, operation or reclamation of the mine project, and to determine whether modifications to project operations or additional mitigation actions would be required to correct any unanticipated impacts encountered, or to prevent future violations of regulatory requirements.

MMC and its predecessors have collected and reported pre-construction or baseline surface and ground water quantity and quality data (see Chapter 3). Additional monitoring would be required to supplement this original data collection and provide long-term monitoring for the project. This monitoring plan does not include all compliance monitoring that may be required by a MPDES permit. Monitoring programs would be maintained during the life of the project. Post-mining surface and ground water monitoring would be continued for a period of time to be specified by the agencies during review of MMC's Final Closure Plan. This plan discusses the monitoring requirements, frequency, reporting, and other important aspects of the monitoring program.

The monitoring program associated with the Libby Adit MPDES permit is currently being implemented. MMC is currently collecting quarterly samples from Outfall 001 for flow rate, temperature, nutrients, sulfate, and metals. When exploration or mining began, MMC would also sample the same parameters quarterly at LB-300.

1.1 Funding

As discussed in section 3.10, *Ground Water Hydrology* and section 3.12, *Surface Water Quality* of Chapter 3, the Board of Health and Environmental Sciences (the Board of Environmental Review's predecessor) approved a "Petition for Change in Quality of Ambient Waters" to increase the concentration of select constituents in surface and ground water above ambient water quality. The Order remains in effect and MMC would be responsible for ensuring compliance with the Order's provisions. One provision of the Order was the funding to the DHES (now DEQ) so that the DEQ could perform sufficient independent monitoring to verify monitoring performed by Noranda (now MMC). Such funding would not exceed the actual cost of such monitoring, and in no case, exceed $35,000 annually (in 1992 dollars). MMC would provide funding to the DEQ for verification monitoring of the project; $35,000 in 1992 dollars is $54,000 (2008 $), using the Consumer Price Index as the inflation factor. The funding would increase annually in accordance with the Consumer Price Index.

However, additional site-specific pre-construction data would be necessary for any new monitoring site that was established to satisfy this monitoring plan to ensure that site-specific baseline data exist prior to construction of each facility. The monitoring program targets both surface and ground water resources located within and outside the CMW. Monitoring objectives would differ between monitoring locations. Some locations mainly in the CMW are focused on

detecting changes in ground water levels and discharge, whereas monitoring locations in the mine facilities area would be more focused on potential contaminant excursions.

Data collection would be initiated in both areas 1 year prior to initiation of construction activities. Once the initial surveys and data collection programs were completed, the plan may be modified to reflect actual field situations identified. Potential impacts to water resources may not occur immediately and for this reason, data collection location and frequency may be adjusted to match the mine development schedule; where appropriate. Monitoring needs for different phases of the project would be considered in the monitoring plan and include pre-construction, construction, mine operation, and post-closure.

MMC would implement the monitoring programs 1 year prior to the start of construction and would collect surface water flows, ground water levels and water quality samples quarterly, and at specific locations, collect at least one sample during or immediately after a storm event that produces runoff. This would assist with understanding pre-construction conditions and establish pre-construction site-specific baseline data for newly installed monitoring locations.

The water resources plan includes monitoring within and adjacent to the CMW would include both surface and ground water resources and is intended to monitor the baseline conditions of waters that lie above and peripheral to the ore body. Monitoring objectives would focus on water quantity, and ground water dependent ecosystems. Water quality would also be monitored and would be important for some locations. The primary objectives for wilderness water resources monitoring are:

- Establish baseline environmental conditions
- Monitor for potential surface and ground water effects during mine construction, operations, and after closure
- Correlate information with hydrology data collected from the underground workings

Wilderness area water resources include:

- Rock Lake (RL)
- St. Paul Lake (SPL)
- Lower Libby Lake (LLL)
- East Fork Bull River (EFBR)
- East Fork Rock Creek (EFRC)
- Springs/seeps/adit discharge above and around the orebody
- Wetlands/riparian areas associated with springs and seeps and streams
- Ground water

Water resources monitoring would also be conducted around the mine facilities and activities. The objective of this monitoring would focus on water quality, aquatic life habitat, wetlands and riparian habitat however water quantity would also be monitored. These water resources include:

- Libby Creek (LB)
- Ramsey Creek (RA)

- Poorman Creek (PM)
- Bear Creek (BC)
- Miller Creek (dependent on the alternative selected) (MC)
- West Fisher Creek (dependent on the alternative selected) (WFC)
- Springs/seeps adjacent to mine operations
- Wetlands/riparian areas adjacent to mine operations
- Ground water adjacent to the adits, LAD Areas and Tailings Impoundment
- Mine Water
- Process Water
- Water Balance

1.2 Ground Water Dependent Ecosystem Inventory

1.2.1 GDE Inventory Objectives

The intent of the monitoring program is to provide long-term monitoring of the water resources and ground water dependent ecosystems that could be impacted by the mine. Prior to construction or underground excavation, MMC would complete a comprehensive ground water dependent ecosystem (GDE) inventory (springs, wetlands, fens, flora, fauna, hyporheic zones, gaining reaches of streams) focusing on areas below about 5,600 feet. The inventory area is shown on Figure C-1. A GDE inventory would be needed because a comprehensive inventory of the resources overlying the proposed mine facilities has not been completed. An inventory would help identify and rank GDEs based on their importance in sustaining critical habitats or species and the most important or vulnerable ones would be targeted for monitoring. The inventory would be conducted in accordance with the most current version of the Forest Service's *Ground-Water Resource Inventory and Monitoring Protocol* (USDA Forest Service 2006a).

1.2.2 Springs Inventory

The inventory area is shown on Figure C-1 would be surveyed for springs. In this initial inventory, the flow of spring would be measured twice, once in early June or when the area was initially accessible, and once between mid-August and mid-September. The most accurate site-specific method for measuring spring flow would be used, which may include the use of a flume, weir, flow meter or timed volumetric measurement. Any spring with a measurable flow between mid-August and mid-September would be assessed for its connection to a regional ground water system, based on flow characteristics (e.g. possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation), water chemistry, and the hydrogeologic setting (associated geology such as the occurrence or absence of colluvium or alluvium).

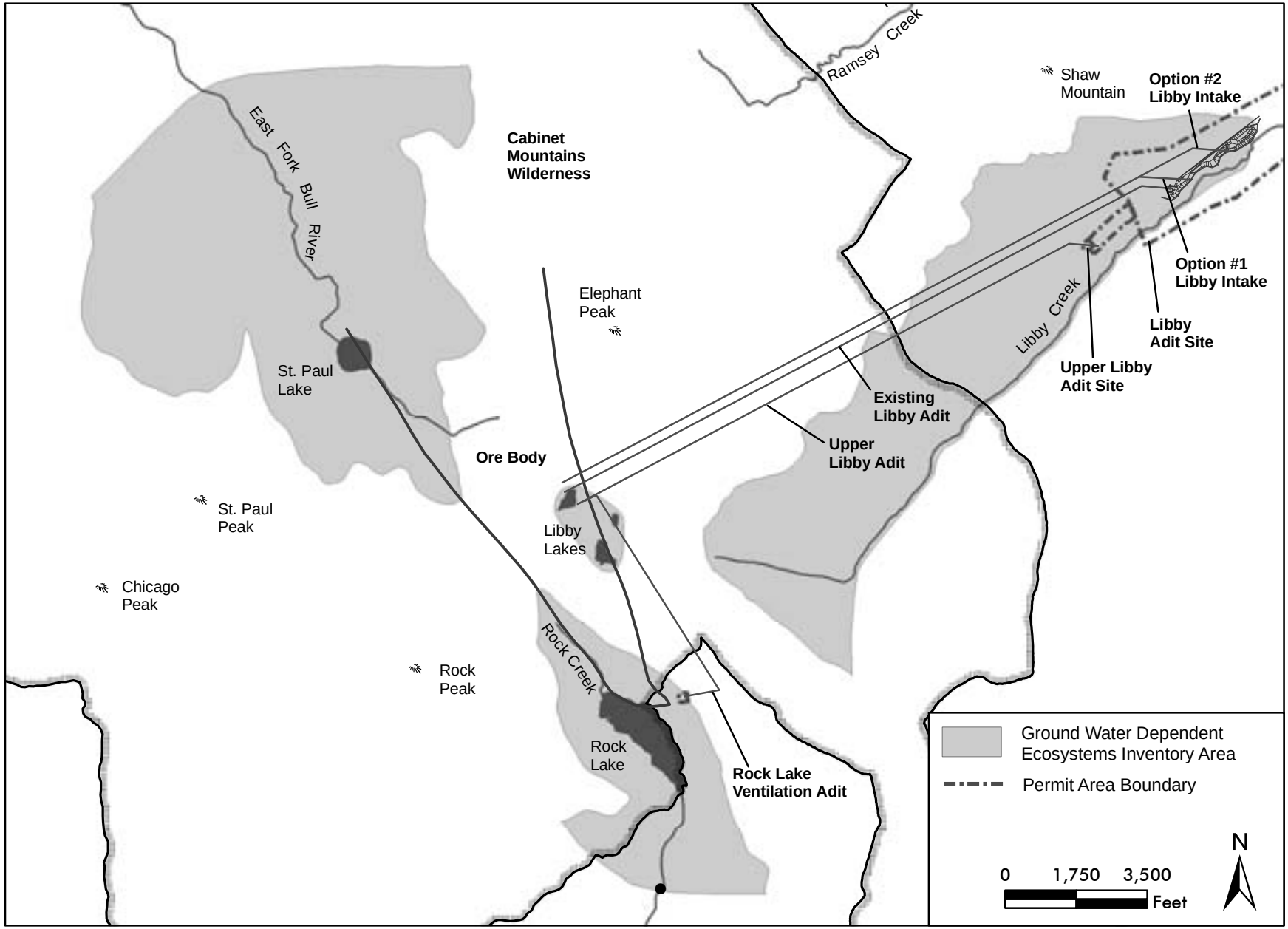


Figure C-1. Proposed Ground Water Dependent Ecosystems Inventory Areas

1.2.3 Wetland and Riparian Vegetation Inventory

The inventory area, shown on Figure C-1, would be surveyed for ground water dependent wetlands, fens and riparian areas. At each critical GDE habitat identified from the inventory, a vegetation survey would be completed. A botanist/plant ecologist or other qualified individual would design survey methodology and protocols which would be approved by the agencies. Initial survey data would include site photos and points, GPS site locations, basic site descriptors, and plant species composition, focusing on hydrophytes (plants that are able to live either in water itself or in very moist soils).

1.2.4 Stream Baseflow Inventory

In the initial inventory, the flow of any stream in the GDE inventory area (Figure C-1) would be measured when the area was initially accessible, monthly during the summer months and weekly between mid-August and mid-September. The most accurate site-specific method for measuring stream flow would be \used, which may include the use of a flume, weir, flow meter or timed volumetric measurement. Any stream with a measurable flow between mid-August and mid-September would be assessed for its connection to a regional ground water system, based on the associated hydrogeology such as faults or the occurrence or absence of colluvium and/or alluvium and possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation. Gaining stream reaches would be mapped, and then monitoring locations would be refined to focus on gaining reach lengths and flow.

1.2.5 Lakes Inventory

Beginning 1 year prior to construction, the levels of Rock Lake, St. Paul Lake, and Lower Libby Lake, which all overlie the proposed mine, would be measured continuously. Each lake would be assessed for its connection to a regional ground water system, based on water balance, the associated hydrogeologic characteristics such as faults or the occurrence or absence of colluvium and/or alluvium and possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation.

1.3 Ground Water Dependent Ecosystem Monitoring

1.3.1 GDE Monitoring Objectives

GDE monitoring would have locations and frequency specified based on inventory data and on the local hydrogeology and proximity to the mine or adit void. The objective of GDE monitoring would be to detect changes in ecological integrity of dependent species and habitat. A GDE Monitoring and Mitigation Plan would be developed for important GDEs found during the inventory that would most effectively detect and minimize stress to flora and fauna from surface effects of mine dewatering. The plan would be submitted to the agencies for approval after the GDE inventory is completed and early enough for 1 year of baseline data to be collected before mining begins. The plan would include piezometers in critical locations. The plan would include a monitoring schedule, a mitigation plan, and mitigation implementation triggers. The results of the initial inventory, subsequent inventories, and monitoring would be reported in annual reports to the lead agencies.

There are several criteria required to decide which characteristics to monitor, including traits that 1) *have a defined relationship with ground water levels*; there needs to be confidence that a

measured response within a parameter reflects altered ground water levels rather than other abiotic/biotic factors; 2) *are logistically practical*; parameters should be practical to measure within the constraints of a wilderness setting; parameters that reflect landscape responses by GDEs of wide distribution, such as remote sensing of hydrophytic vegetation health, could be considered; 3) *have early warning capabilities*; it is important to consider the lag time between changed ground water levels and environmental condition or health. The response of vegetation parameters influenced by changed ground water levels can take a long time to become manifest and further reductions may occur before impacts of previous changes are realized; consequently, parameters with rapid responses are favored (e.g. piezometers), as they provide advanced warning of significant stress or degradation on the system, as well as providing the opportunity to determine whether intervention or further investigation is required. Nevertheless, some GDE values may have to be measured through parameters with a greater lag time (e.g. hydrophytic vegetation community composition).

Table C-1 below identifies the specific monitoring options for surface resources in the area. After the initial survey, this table would help to establish the methods that would be used to monitoring GDEs.

Table C-1. Ground Water Dependent Ecosystem Monitoring Options, Alternative 3 and 4.

Surface Resource Component	Look For:	Using:
Springs, Lakes, and Streams	Flow changes	Flow monitoring
	Lake level changes	Continuous level recorder
	Ground water level changes	Piezometers
Wetland and Riparian Vegetation	Ground water level changes	Piezometers
	Dieback, early desiccation, habitat decline	Photo points, field surveys, remote sensing
	Soil moisture stress	Tensiometers
	Plant water potential/ turgor pressure changes	Pressure bomb technique
Amphibians, Mollusks, Macroinvertebrates, Fish	Population decline, community composition change	Field surveys
Terrestrial animals	Population/usage decline	Field surveys

1.3.2 Springs Monitoring

The flow in springs determined to be supported by the regional ground water system or whose connection to the regional ground water system was uncertain would be measured annually between mid-August and mid-September. A spring that was determined, after repeated flow measurements, not to be connected to the regional ground water system may be eliminated from additional monitoring. However, additional monitoring of flow and quality of any spring overlying the proposed mine may be required, depending on the outcome of the GDE inventory. Flow monitoring of springs or streams, by itself, is generally inadequate because mining induced impacts are frequently subtle and hard to distinguish from natural variability. Flow monitoring can only detect relatively large mining induced changes in flow.

1.3.3 Wetland and Riparian Vegetation Monitoring

Indicator hydrophytes and their distribution and frequency would be chosen from the initial survey information and identified as "trigger plants." Trigger plants would serve as a basic "trigger" to begin annual monitoring in a particular site. Other monitoring options such as piezometers would be used to facilitate or strengthen monitoring effectiveness. If a change in seep or spring flow, water level, or water quality is noted outside the baseline data for an individual site or set of sites, then a re-evaluation of those potentially affected habitats would be conducted and documented for comparison against initial survey information. Depending on a combination of biological or physical variables or the severity of plant indicator decline, the lead agencies may require more rigorous monitoring. Potential monitoring options for wetlands (including fens) and riparian areas are shown in Table C-1.

1.3.4 Stream Baseflow Monitoring

Streamflow determined to be supported by the regional ground water system or whose connection to the regional ground water system was uncertain would be measured continuously for water level changes between July 15 and October 15 every year. Where streamflow was determined, after repeated flow measurements, not to be connected to the regional ground water system, such locations may be eliminated from additional monitoring. However, additional monitoring of streamflow and water quality of any stream overlying the proposed mine may be required, depending on the outcome of the GDE inventory.

1.3.5 Lake Monitoring

Lake monitoring would include indicators to assess trophic status, ecological integrity and lake physical characteristics. MMC would implement monitoring at Rock Lake, St. Paul Lake and Lower Libby Lake at least 1 year prior to the start of mining to provide data to establish the pre-construction water balance of the lakes. Lake monitoring should be based on the EPA and Forest Service lake monitoring protocols (USDA Forest Service 2001, 2006a, 2006b; EPA 2007b). Major water budget variables would be accounted for and/or estimated, including evaporation, precipitation, seepage, and surface water inflows and outflows, as well as the continuously recorded lake levels, to develop lake water balances. The lake monitoring system design and evaluation would be coordinated with the KNF and the DEQ because of physical difficulties such as access, vandalism, avalanches, and reliability of the data. Lake monitoring would continue throughout the mining period. When mining is completed, the agencies would determine if continued monitoring of the lakes is needed. Pre-construction water balances and trend observations would be used to determine whether the lake levels were affected during mining operations. MMC would collect lake water quality data quarterly beginning 1 year prior to construction. This would include samples from the lake inlet, outlet and the deepest part of the lake. Samples would be collected as soon as the lakes melt in the spring, during mid-summer, late summer, and in the fall before the lakes freeze. Monitoring data and evaluation (lake water balance and water quality) would be submitted to the lead agencies within 30 days after quarterly water quality data collection.

A permanent index location for lake water quality sampling should be determined during the first year of sample collection using a depth finder and by triangulation with landmarks around the lake. This location should have good hydrologic connection with the main mass of water and should be in the deepest area of the lake. Each time the lake is to be revisited for sampling the index location should be relocated as close as possible (USDA Forest Service 2006a). Each lake

would need to be measured to determine if the lake is thermally stratified (method is described in USDA Forest Service 2006a). For thermally mixed lakes, one epilimnion (upper warm water) would be collected at the index location at a depth of 0.5 meter below the lake surface. For thermally stratified lakes such as Rock Lake, two samples would be located at the index location at a depth of 0.5 meter below the lake surface and hypolimnion (lower cold water) sample would be collected at a depth determined 3 meters below the thermocline (the transition zone between the epilimnion and hypolimnion) or at the mid-depth of the hypolimnion, whichever is the lesser to minimize the chance of hitting the lake bottom and kicking up sediment. A Van Dorn sampler should be used to collect the deeper water sampler.

1.4 Surface Water Monitoring

Surface water monitoring would be divided between those locations where water quality could be affected mainly by dewatering from the adits and underground workings (Quantity Focus Locations) and those that could be affected by mine activities (Quality Focus Locations). Surface water monitoring stations would include sites shown in Figure C-2.

1.4.1 Quantity Focus - Locations

Quantity focused surface water sites would be monitored for flow and a limited list of indicator quality parameters during the life of the project. Initially, water quality may be measured for a larger set of parameters to obtain information prior to mine activities and then monitored for a smaller set of key parameters throughout project life (Table C-2). If changes to flow or quality are deemed to be significant, then additional monitoring may be required to determine if the changes are mine related.

Quantity Focus surface water monitoring stations (Table C-2) include:

- East Fork Rock Creek (EFRC)
- East Fork Bull River (EFBR)
- Rock Lake (RL)
- St. Paul Lake (SPL)
- Lower Libby Lake (LLL)
- Key monitoring sites identified following the GDE inventory

The monitoring locations were chosen based on where baseline sampling has occurred and/or where construction or mining operations may most likely affect surface water flow. The locations are proposed and could be subject to change. Likewise, additional sites may be added following the results of the GDE Inventory and/or agency review. Surface water monitoring locations for the project would be based on final agency review and approval.

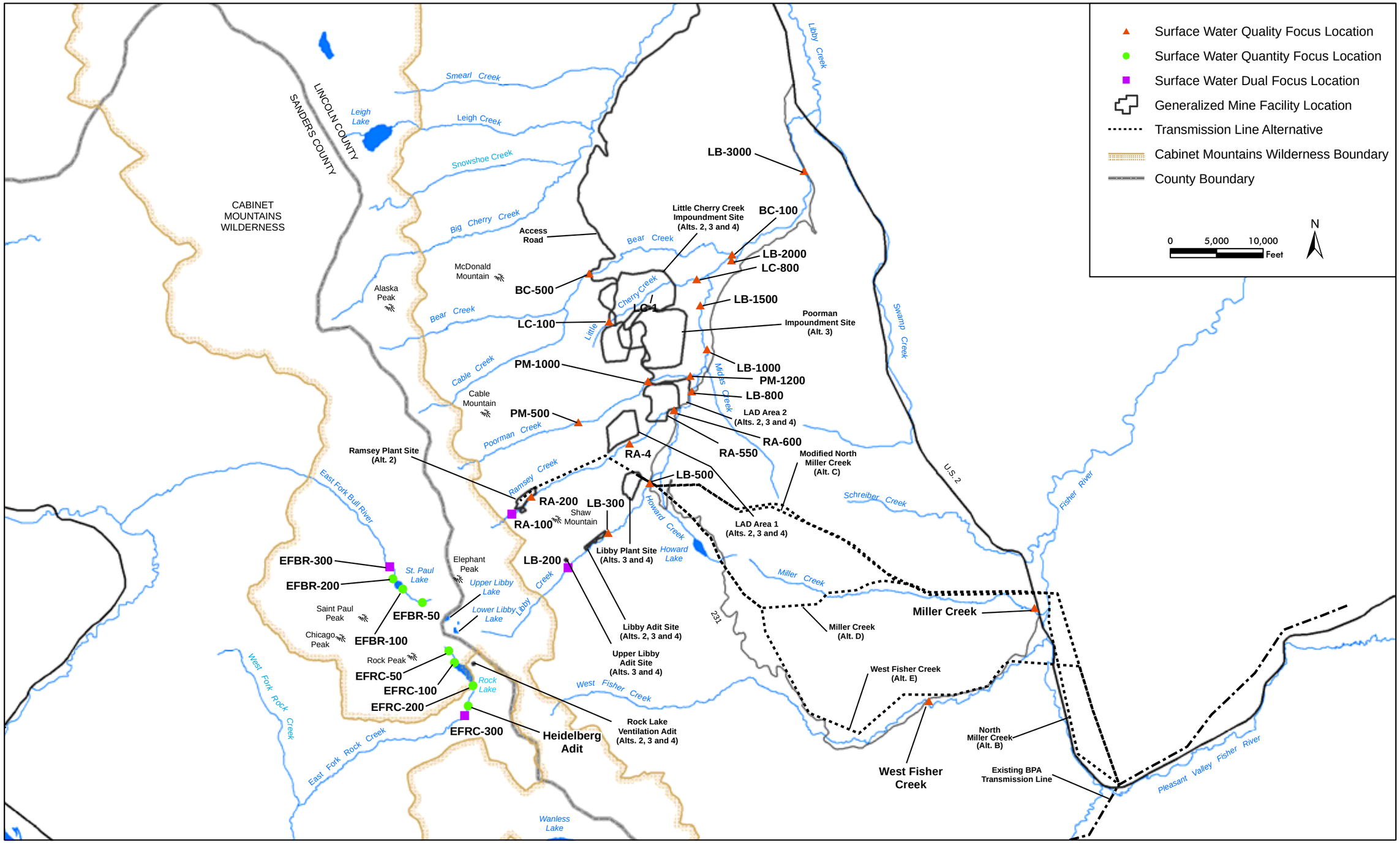


Figure C-2. Proposed Surface Water Monitoring Locations

1.4.2 Quantity Focus - Frequency

If accessible, monitoring would occur in the streams/lakes listed in Table C-2 at the following frequency:

- Early spring low flow conditions
- High flow (snowmelt runoff)
- Late summer (base flow)
- October-November (fall low flow)

The flow of Rock Creek above Rock Lake (EFRC-50) would be measured between July and October using a flume or weir that could measure low flow. Water levels would be recorded continuously. The purpose of this monitoring would be to identify when base flow occurs, to quantify the base flow and to detect possible reductions in base flow. A continuous flow station would also be installed at EFRC-200 and data would be collected when the stream is accessible and not frozen. Spring monitoring would occur at springs during June high flow snowmelt runoff, or when accessible, and between mid-August and mid-September during the late summer base flow period.

Table C-2. Surface Water Monitoring Sites – Quantity Focus Locations.

Station	Location	Alternative	Objective
East Fork Rock Creek			
New EFRC-50	Just below SP-31	All	Monitor dewatering
EFRC-100	Above Rock Lake	All	Monitor dewatering
EFRC-200	Below Rock Lake where measurable (such as at exposed bedrock slightly downstream from lake)	All	Monitor dewatering
EFRC-300	Above Rock Creek Meadows	All	Monitor dewatering
Heidelberg Adit	Below Rock Lake	All	Monitor dewatering
East Fork Bull River			
New EFBR-50	Just below SP-32	All	Monitor dewatering
New EFBR-100	Above St. Paul Lake, where stream crosses exposed bedrock	All	Monitor dewatering
New EFBR-200	Below St. Paul Lake where measurable	All	Monitor dewatering
New EFBR-300	At base of steep slope below St. Paul Lake where measurable	All	Monitor dewatering
Libby Creek			
LB-200	Above Libby Adit	All	Monitor dewatering
Ramsey Creek			
RA-100	Near Ramsey Adits	All	Monitor dewatering
Wilderness Lakes			
Rock Lake	Continuous water level recorder	All	Monitor dewatering
St. Paul Lake	Continuous water level recorder	All	Monitor dewatering
Lower Libby Lake	Continuous water level recorder	All	Monitor dewatering

1.4.3 Quantity Focus - Parameters

A select list of water quality parameters to be sampled for and analyzed at each surface monitoring location is provided in Table C-3. As mentioned earlier, additional baseline information may be collected prior to mine activities, but routine monitoring of wilderness waters would only include a small set of key variables that are most likely to show change over time. Flow measurements would also be taken. Laboratory analytical methods should conform with those listed in 40 CFR 136. Laboratory detection limits would need to be low enough to detect existing water quality concentrations and, therefore, changes in water quality concentrations in lakes, streams and springs.

Table C-3. Proposed Monitoring Parameters and Detection Limits – Quantity Focus Locations.

Parameter	Detection Limit
Flow	
pH (s.u.)	
Dissolved Oxygen	0.1
Specific Conductivity (µS/cm)	1.0
Turbidity	

1.4.4 Quality Focus Locations

The following surface water monitoring is being developed to establish baseline environmental conditions as well as resource monitoring during mine operations. The surface water monitoring would be focused on water quality but water quantity is also important. Water quality issues would vary depending on the planned mined activities. This plan is developed to focus on the specific water quality issues for each discreet project facility (i.e. tailing impoundment, LAD Areas). In addition, aquatic habitat would be monitoring with the same objective and is described in *Aquatic Biology Monitoring*. Table C-4 provides the general objectives for each area.

Table C-4. Surface Water Monitoring Objectives – Quality Focus Locations.

Mine Area	Stream Areas	Objective
Ramsey Plant Site	Libby Creek – middle reaches Ramsey Creek – middle reaches)	Sediment, Habitat, Water Quality (flow)
LAD Areas	Ramsey Creek – lower and middle reaches Poorman Creek – lower and middle reaches	Sediment, Habitat, Water Quality (flow)
Libby Adit and Libby Plant Site	Libby Creek – upper and middle reaches	Sediment, Habitat, Water Quality (flow)
Tailings Impoundment	Little Cherry Creek Libby Creek – middle reaches	Sediment, Habitat, Water Quality (flow)
Underground void	EFRC-300	Water Quality
Underground void	EFBR-300	Water Quality

Surface water would be monitored for quality and flow during the life of the project for the majority of monitoring stations. For some locations, monitoring would be conducted only to detect impacts during the construction period. Surface water monitoring stations would include the following sites shown in Figure C-2 and provided in Table C-5:

- Libby Creek
- Ramsey Creek
- Little Cherry Creek
- Poorman Creek
- Unnamed Tributary of Miller Creek (if the North Miller Creek TL Alternative or Modified North Miller Creek TL Alternative was chosen) – Construction Only
- Miller Creek (if the Miller Creek TL Alternative was chosen) – Construction Only
- West Fisher Creek (if the West Fisher Creek TL Alternative was chosen) – Construction Only
- Bear Creek (if Alternative 2 or 4 was chosen)
- Springs
- Other monitoring sites identified following the GDE Inventory (springs/seeps/streams) within the project areas (adit, plant site, with or downgradient of the LAD Areas, and within or downgradient of the tailings impoundment

In alternatives 3 and 4, an identified spring between the two LAD Areas (SP-21 see Figure 72) would be part of the monitoring. The sample locations were chosen based on where baseline sampling has occurred and/or where construction or mining operations may most likely affect streamflow and/or water quality. The locations are proposed and could be subject to change or additional sites may be added. Surface water monitoring locations for the project would be based on final agency review and approval.

1.4.5 Quality Focus - Frequency

Monitoring would occur in the streams listed in Table C-5 at the following frequency:

- March-April (early spring, low flow)
- June, high flow (snowmelt runoff)
- August-September (late summer base flow)
- October-November (fall low flow)

In addition, in-stream flow and water quality samples would be collected during or immediately after at least one storm event that produces observable surface runoff. Sample time periods may be changed to better represent stream conditions, based on flow data collected. Spring monitoring would occur in the springs listed in Table C-5 during June high flow snowmelt runoff and in August to September during the late summer base flow period.

1.4.6 Quality Focus - Parameters

Water quality parameters to be sampled for and analyzed at each surface monitoring location are provided in Table C-6. Laboratory analytical methods should conform with those listed 40 CFR

136. Laboratory detection limits would need to be low enough to detect existing water quality concentrations and, therefore, changes in water quality concentrations in surface water.

Continuous flow stations would be installed at LB-2000, EFRC-200, EFBR-100, and in Libby Creek and Ramsey Creek at the CMW boundary and measurements collected when the streams are not frozen. Other continuous flow stations may be installed based on the GDE stream inventory at locations determined to be gaining streams supported by the regional ground water system.

The following sediment sampling schedule would be established for sediment and turbidity sampling at LB-2000:

- Daily (during construction activities)
- Every other day (during initial mine operation)
- Once per week (during mine operations/reclamation).

If possible, daily suspended sediment samples and turbidity measurements would be collected with an automated sampler. If samples were not collected with an automated sampler, then daily samples would be collected using a depth integrated sampler at various times during each of the three shifts during construction. This could be reduced to every other day collection during the three shifts once mine operations were initiated. After the initial mine development, the samples could be reduced to weekly or as required by the MPDES permit monitoring stipulations. Sample collection times would be selected to reflect representative mine activities.

Weekly suspended sediment sampling and turbidity measurements would occur during construction of the transmission line immediately below any and all stream crossings and would occur within 36 hours after a storm causing surface runoff. Weekly sediment sampling and sampling within 36 hours after a storm (this intensity of sampling would allow for the majority of the sediment to settle out before measurement. I would suggest that we require “storm –event sampling” to occur during the event not 36 hours after it) causing surface runoff also would occur in streams located within 0.25 mile of disturbed areas greater than 1 acre in size during construction activities, including, but not limited to the mill site, borrow areas, tailings impoundment, adits, waste rock storage areas, land application disposal areas and access roads.

For the transmission line monitoring sites, samples would be collected weekly at all major stream crossings during construction and analyzed for specific conductivity and turbidity. After construction of the transmission line was complete, water quality sampling would no longer be required unless erosion into the stream continues to be observed where the transmission line was located adjacent to or crosses the stream.

Table C-5. Proposed Surface Water Monitoring Locations – Quality Focus Locations.

Station	Location	Alternative	Purpose
		Libby Creek	
LB-200	Above Libby Adit	All	Reference station on upper Libby Creek
LB-300	Upstream of Howard Creek Confluence	All	Assess Libby Creek adit site areas
LB-500	Near Libby Plant Site	Alternatives 3 and 4	Assess Libby Creek Plant site
LB-800	Near LAD Areas	Alternative 2	Monitor LAD discharge
LB-1000	Downstream of Poorman Creek/Midas Creek Confluence	All	Monitor Ramsey Plant Site and LAD Areas
LB-1500	Downstream of LB-1000 about 3,000 feet, downstream of Poorman TI site	Alternative 2	Monitor Poorman Tailings Impoundment site
LB-2000	Downstream of Little Cherry Creek Confluence	All	Monitor Below the Tailings Impoundment
LB-3000	Upstream of Crazyman Creek Confluence	All	Monitor Cumulative Activities
		Ramsey Creek	
RA-100	Above Ramsey Plant Site	Alternative 2	Reference station on upper Ramsey Creek
RA-200	Below Ramsey Plant Site	Alternative 2	Monitor Plant Site, outfall 008
New RA-400	Below LAD Area 1	All	Monitor LAD discharge
RA-600	Above Libby Creek Confluence	All	Monitor lower LAD discharge
		Little Cherry Creek	
LC-100	Above tailings impoundment	Alternatives 2 and 4	Reference station on upper L. Cherry Creek
LC-800	Above Libby Creek Confluence	Alternatives 2 and 4	Monitor tailings area activities
		Poorman	
PM-500	Upstream on Poorman Creek	All	Reference station on upper Poorman Creek
PM-1000	Above Libby Creek Confluence	Alternatives 3 and 4	Monitor LAD discharge
New PM-1200	Below LAD Area 2	Alternative 2	Monitor lower LAD discharge outfall 007
		Bear Creek	
BC-100	Below tailings impoundment	Alternatives 2 and 4	Monitor project activities
BC-500	Above any disturbance and NFS road #278	Alternatives 2 and 4	Provide reference on upper Bear Creek
		East Fork Bull River	
EFBR-300	At base of steep slope below St. Paul Lake where measurable	All	Monitor mining activities
		East Fork Rock Creek	
EFRC-300	Above Rock Creek Meadows	All	Monitor mining activities
		Drainages In Transmission Line Areas	
Miller Creek	Upstream of Fisher River	Alternatives B, C and D	Monitor transmission line construction
West Fisher Creek	Approximately 2.5 mi above Fisher River at NFS road #231 crossing	Alternative E	Monitor transmission line construction

Table C-6. Proposed Monitoring Parameters and Detection Limits – Quality Focus Locations.

Parameter (Non-metals)	Detection Limit (mg/L unless otherwise specified)	Parameter (Metals total recoverable unless otherwise specified)	Detection Limit (mg/L)
pH (s.u.)	0.1	Aluminum, dissolved (0.45 μm filter)	0.03
Dissolved oxygen	0.1	Antimony	0.003
Specific conductivity (μS/cm)	1.0	Arsenic	0.001
Total dissolved solids	1.0	Barium	0.005
Total suspended solids	1.0	Beryllium	0.001
Sodium	1.0	Cadmium	0.0001
Calcium	1.0	Chromium	0.001
Magnesium	1.0	Copper	0.001
Potassium	1.0	Iron	0.05
Carbonate	1.0	Lead	0.0005
Bicarbonate	1.0	Manganese	0.005
Chloride	1.0	Mercury	0.00001
Sulfate	1.0	Nickel	0.01
Nitrate+nitrite, as N	0.01	Selenium	0.001
Total Kjeldahl nitrogen, as N	0.1	Silver	0.0002
Total phosphorus,as P	0.005	Thallium	0.0002
Ortho-phosphate	0.005	Zinc	0.001
Ammonia, as N	0.05		
Field temperature	-		
Total alkalinity (as $CaCO_3$)	1.0		
Total hardness (as $CaCO_3$)	1.0		
Turbidity (NTU)	0.1		
Chemical oxygen demand‡	5.0		
Oil and grease‡	1.0		

‡For discharges associated with stormwater runoff.

1.5 Ground Water Monitoring

1.5.1 Introduction

Ground water monitoring would be required for the purpose of detecting water quality impacts from mine area facilities and for detecting ground water level changes from the underground mine and adits. A summary of all ground water monitoring requirements are shown on Table C-7.

Table C-7. Summary of Ground Water Monitoring Requirements.

Well Number	Location	Depth/Screen Interval	Required Data	Monitoring Frequency	Purpose
Libby Creek Drainage					
MW07-1 and MW07-2	Downgradient of adit facilities	Existing wells at Libby Adit	Water Levels Water Quality	Quarterly	Assess potential impacts from Libby Adit discharge
Ramsey Creek Drainage					
3	Upgradient Plant Site	WT plus 50 feet	Water Levels Water Quality	Quarterly	Background data
4	Downgradient Plant Site	WT plus 50 feet	Water Levels Water Quality	Quarterly	Assess potential impacts from Plant site
LAD Area 1					
5s and d, 6s and d, and 7s and d	Downgradient of LAD 1	s: 0 – WT plus 20 feet d: WT plus 20 feet – WT plus 50 feet	Water Levels Water Quality	Monthly	Assess potential impacts from land application
LAD Area 2					
8s and d, 9s and d, and 10s and d	Downgradient of LAD 2	s: 0 – WT plus 20 feet d: WT plus 20 feet – WT plus 50 feet	Water Levels Water Quality	Monthly	Assess potential impacts from land application
Little Cherry Creek Impoundment Site for Alternatives 2 and 4; Poorman Impoundment Site for Alternative 3					
11	Upgradient tailings impoundment	WT plus 50 feet	Water Levels Water Quality	Monthly	Background data
12 – 18	Downgradient of seepage collection system	Nested pairs – screened in surficial (if sat.) material and bedrock	Water Levels Water Quality	Monthly	Assess potential impacts from impoundment seepage
Mine and Adits					
19s and d	Adjacent to Rock Lake	s: 0 – 100 feet d: 150 – 250 feet	Water Levels	Continuous	Assess potential impact to ground water
20s and d	Adjacent to Rock Lake Fault	s: 0 – 300 feet d: 400 – 500 feet	Water Levels	Continuous	Assess potential impact to ground water
Numerous (see Figure C-3)	From within adit(s) and mine void; drilled radially in all major directions	100's to 1,000 feet from the adit/mine	Water Levels	Continuous	Monitor changes in ground water pressure as adits/mine advance

WT = water table; s = shallow; d = deep

1.5.2 Mine and Adits

Ground water monitoring for the mine and adits would include a variety of approaches, partly because much of the area above the mine and adits is in the Cabinet Mountains Wilderness (CMW) and, therefore, additional ground water monitoring wells cannot be easily installed. In addition to monitoring water level changes resulting from the mine and adit inflows, a secondary objective of the mine ground water monitoring program is to provide detailed hydraulic information from the water-bearing fractures so that a better predictive ground water model can be constructed by MMC. A three dimensional ground water model calibrated against actual head and flow information could be used to more accurately predict possible impacts to specific water bodies, such as Rock Lake, or specific springs, such as those along Rock Creek.

As the mine and adits were constructed and ground water flowed into the openings, hydraulic pressures within the fractures would change rapidly. Therefore, it would be important that ground water head data be collected prior to, and during construction along with mine inflow data early in the construction process. Once ground water levels have declined, this important data would no longer be available. As part of the Libby Adit evaluation program, MMC would extend the Libby Adit into the vicinity of the ore body (about 2,000 feet from its current terminus) and several drifts would be constructed to permit drilling from numerous underground pads to better define the ore body. Dewatering of the existing Libby Adit, extension of the adit, and construction of additional drifts and boreholes would start the dewatering process predicted for the mine void and adits. Therefore, it is essential that provisions for ground water level monitoring be established before the Libby Adit extension begins.

In addition to monitoring ground water pressure changes from underground, piezometers drilled from the surface would be installed in the vicinity of Rock Lake and the Rock Lake Fault to monitor ground water level changes over the proposed underground workings.

Different information is gathered from piezometers drilled from the surface verses those drilled from underground. Surface piezometers are important for establishing baseline or pre-construction head distributions in the aquifer and record changes as mining progresses. They are also important for monitoring rebound of the ground water system after the adit is closed and underground piezometers are no longer accessible. Underground piezometers are useful for showing the changes in head distributions around the opening and the effects of grouting. The disadvantages are that they do not record pre-construction head distributions and they are not accessible to track rebound after the mine is closed.

1.5.2.1 Piezometers Located at the Ground Surface

Ground water level monitoring can be accomplished using both surface drilled boreholes and subsurface boreholes drilled from within the adit or drifts. Because the permitting process to install monitoring wells from the surface may require considerable time, the permitting process would be started as soon as possible to ensure that the wells would be available prior to mining.

Water balance monitoring of lakes can be difficult and time consuming. The most precise method for monitoring effects to aquifers and dependent surface water features is through the use of surface piezometers. Piezometers record changes in aquifers from mining that could never be detected in surface water flow monitoring. This is because the low storage in fractured bedrock aquifers results in large changes in water level for a small perturbation in the system. Surface

piezometers are important for establishing baseline or pre-construction head distributions in the aquifer and are important for monitoring rebound of the ground water system after the adit is closed and underground piezometers are no longer accessible. Because ground water inflow and outflow is a component of the Rock Lake water balance, monitoring of the underlying, connected aquifer is essential.

Surface-based ground water monitoring would include a pair of piezometers adjacent to Rock Lake, screened at different depths (deep and shallow) for the purpose of monitoring the vertical head gradient in the saturated zone beneath the lake. Changes in the vertical gradient would indicate a mining effect to the aquifer that supports the lake water balance. The piezometers would be located close to the lake, preferably on the private land on the northeast side of the lake. Continuous recording data loggers would be installed as soon as the piezometers were completed and would be maintained during the construction, operation, and post-construction (recovery) periods. Water level measurement data would be measured at least four times per day. The data logger would be downloaded during any visit to Rock Lake to collect other monitoring data, but can be operated without downloading throughout the winter months when access is not possible.

A second pair of piezometers with a transducer and continuous recorder would be installed in the CMW uphill from Rock Lake (about 0.25 to 0.3 mile from the lake) on the east side of the Rock Lake Fault. These deep and shallow piezometers would monitor changes in ground water levels and vertical head gradients above the underground workings. Measurement and download frequencies would be the same as described for the piezometers at Rock Lake.

1.5.2.2 Underground Piezometers

Because the Libby Adit and associated drifts and boreholes would be located over a very large area partially beneath the CMW, the most efficient means for obtaining ground water level data would from within the mine voids. However, because the ability to drill from within the mine voids may be limited to about 400 feet, based on the MMC exploration program, numerous piezometers would be required (Figure C-3). The limitations to underground piezometers are that they do not record pre-construction head distributions and they are not accessible to track rebound after the mine is closed.

An array of small diameter boreholes would be installed from within the mine and adits, and instrumented with continuous recording pressure transducers. The boreholes would be drilled in a radial pattern from the mine or adits so that the degree of heterogeneity can be assessed as heads change in the fractures surrounding the adit or mine. Each drill station would consist of two boreholes, drilled approximately 30 degrees from the horizontal from adit or drift, 180 degrees apart, and a third borehole drilled vertically upward from the drift or adit (Figure C-3). The location of the piezometers for the first phase of exploratory mining is shown on Figure C-3. These locations could be modified based on the actual hydrogeological conditions encountered after review and approval by the agencies.

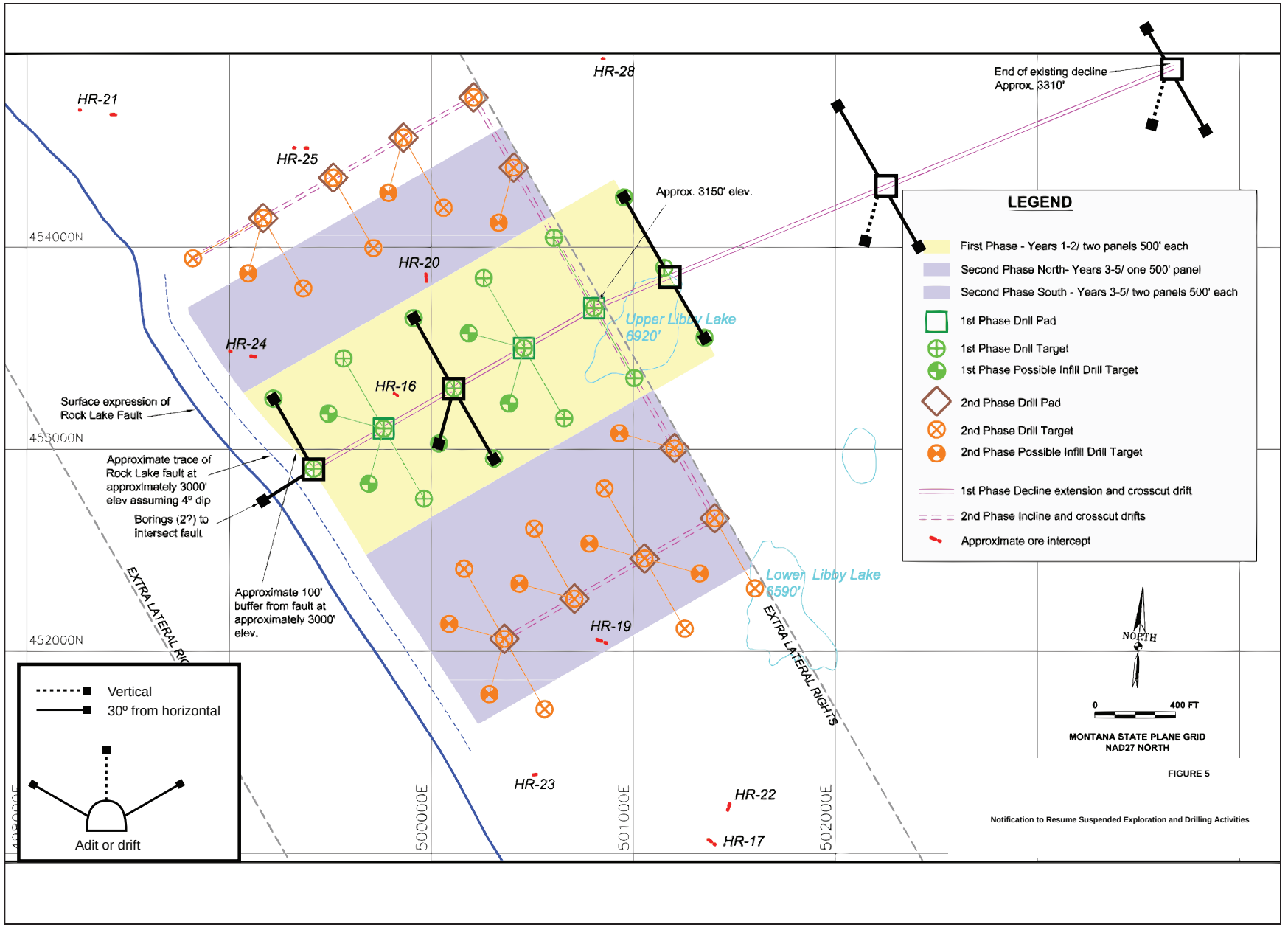


Figure C-3. Proposed Underground Piezometers

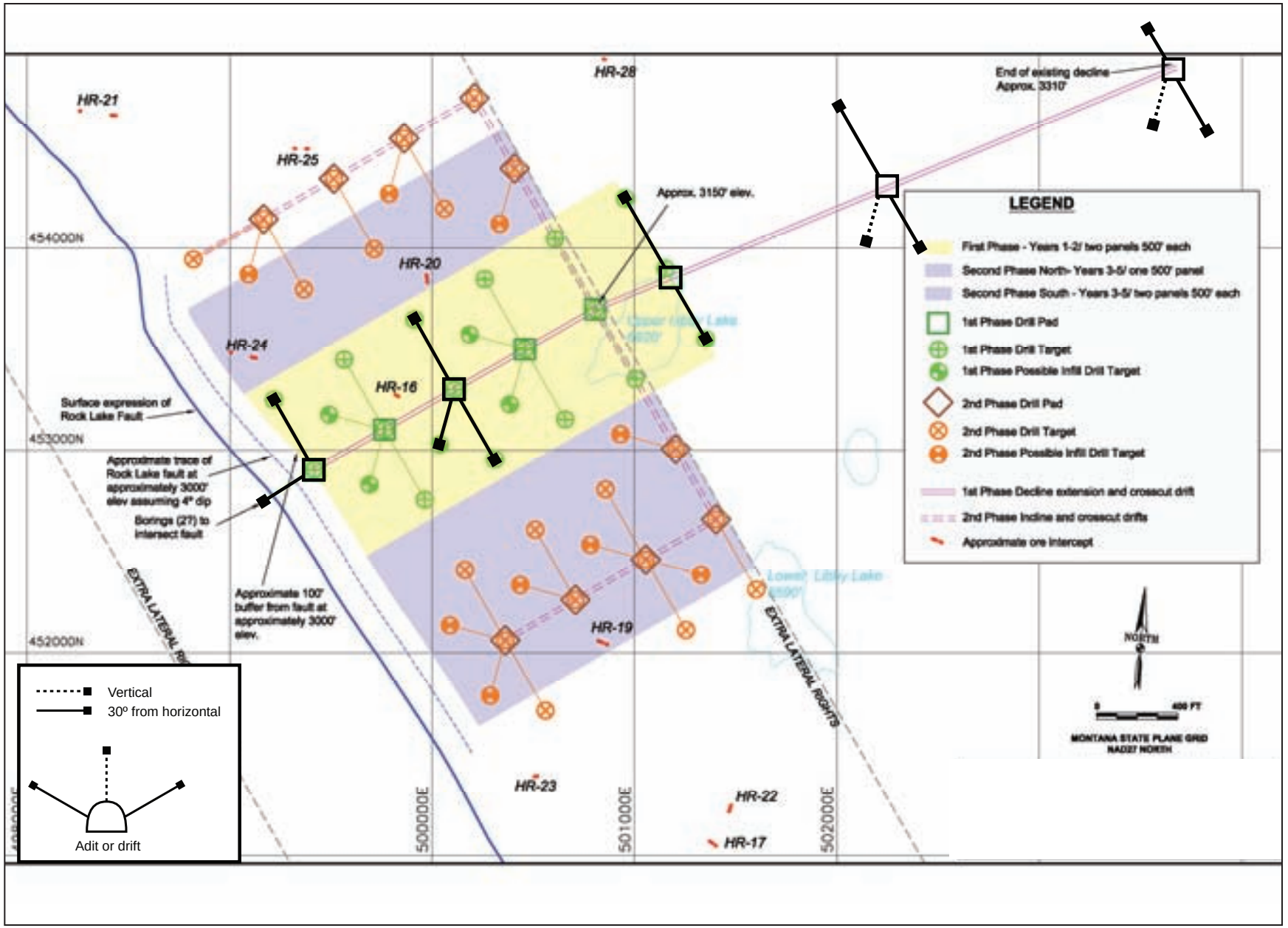


Figure C-3. Proposed Underground Piezometers

The first station would be located at the current terminus of the Libby Adit. The purpose of these piezometers is to start recording water levels as soon as possible after dewatering the existing adit. Water levels in the fractures in the surrounding rock would begin responding as soon as dewatering begins and rather than waiting until the adit is extended, these piezometers would record hydraulic response as the adit is extended with the associated dewatering. A second station on the Libby Adit would be located about half way between the current terminus and the ore body (about 1,500 feet). All subsequent monitoring stations, as shown in Figure C-3, would use planned exploration boreholes so that no additional boreholes would be required.

The underground piezometers would be constructed to permit continuous monitoring of ground water pressure at one or more intervals in each borehole. This can be accomplished by use of inflatable packers (of appropriate pressure rating) to isolate specific intervals for either the insertion of multiple transducers into a borehole or the installation of tubing that extends to the surface of the drift or adit from each interval. This approach would permit pressure monitoring of specific intervals in each borehole. At least, the deepest 25 feet would be isolated for monitoring and at least one additional zone closer to the drift or adit (for example, 100 feet from the drift or adit). Grout of sufficient length could be used to isolate zones, rather than packers, but the transducers or tubing would therefore be permanent. If packers were used, a provision to maintain their pressure at all times would be required, such as a gas cylinder and pressure regulator, and a program for regular cylinder replacement. Any borehole used for measuring ground water pressure would have to be spatially oriented and located so the information could be used for analysis.

The ground water pressure would be continuously recorded using either a transducer with a built in datalogger or with separate transducers and datalogger(s). The data would be recorded 12 times per 24 hours and would be downloaded at least quarterly to ensure proper operation of the equipment, status of battery power for the dataloggers, and to establish ground water pressure trends.

1.5.2.3 Phase II Water Level Monitoring

MMC proposes to extend drifts and install drill pads in two exploration phases: Phase I—Years 1 and 2, and Phase II—Years 3 to 5. Additional water level monitoring sites would most likely be required during Phase II. However, the location and number of sites would be determined after reviewing water level data collected during the first 2 years to evaluate the response of the ground water system to dewatering and whether the existing monitoring network density was sufficient. A plan would be developed for the additional piezometers to be installed in the remainder of the underground mine production area based on information gathered from the exploration phase.

Ground water quality is not expected to change during mine construction and operation; therefore, other than collecting additional baseline data and required samples of mine inflow water, no specific water sampling would be required. A post mining ground water sampling plan would be developed 3 to 4 years prior to mine closure. The plan would incorporate monitoring information obtained during the mining period in the design of sampling locations and sampling frequency.

1.5.3 Tailings Impoundment

In all alternatives, a seepage collection system beneath the tailings impoundment and dam would be built to minimize net seepage to ground water from the tailings impoundment. At least seven

ground water monitoring wells would be installed downgradient of the dam prior to construction of any of the facilities. At least four of these wells would be constructed as nested pairs to monitor both shallow and deeper flow paths from the impoundment. The objective of the monitoring wells is to detect and track any change in water quality or water levels due to seepage from the impoundment that was not captured by the seepage collection system. The wells would be located so that the cross-sectional area below the impoundment was adequately covered by the monitoring wells. If any preferential flow paths were encountered during the construction of the impoundment or installation of monitoring wells, they would be monitored independently. The installation of two pairs of nested wells is intended to monitor a reasonable vertical thickness of the saturated zone, given the hydrogeologic uncertainty of the area.

1.5.4 LAD Areas

MMC would install ground water monitoring wells prior to mine construction to establish pre-construction ground water conditions. If the lead agencies determine additional monitoring wells were required for land application in the tailings area, these also would be installed prior to construction activities. Monitoring wells would be located to monitor ground water quality downgradient of each LAD. Prior to operation of any LAD Area, ground water level data obtained from the new (and existing) monitoring wells would be used to construct a ground water level contour map. Additional monitoring wells would be installed if the ground water level contour map indicates that ground water downgradient of the LAD Areas was not being fully monitored by the initial set of monitoring wells.

The primary objective the of LAD Area ground water monitoring wells would be to monitor changes in water quality below the LAD Areas as an indicator of the performance of the LAD Areas. Because of the uncertainty in the expected treatment of such compounds as nitrate and ammonia by the LAD Areas, ground water quality downgradient of the LAD Areas would be used to determine the effective of LAD treatment. If nitrate or ammonia concentrations show an upward trend in ground water, MMC would undertake several sequential actions. MMC would notify the lead agencies within 2 weeks and initiate twice-a-month monitoring of all adjacent surface and ground water stations. If concentrations continued to increase and a threshold value for nitrate was exceeded in ground water downgradient of the LAD Areas, use of the LAD Areas for water disposal would cease until the nitrate concentration of the applied water was reduced by pretreatment.

The monitoring wells would be sampled quarterly for water quality parameters for 1 year after the wells were installed to establish pre-operation conditions. The wells would be sampled monthly when water was applied to the LAD Areas. Monthly sampling would continue for at least 1 year following the cessation of discharges.

At the end of the first monitoring year and following submittal of the annual report, MMC would meet with the lead agencies to discuss the monitoring results and evaluate the effectiveness of the land application treatment system. Following the annual review, the lead agencies would decide whether a change in monitoring or operations would be required. MMC would present the details of additional monitoring in the final water management/treatment plan to be submitted to the lead agencies for review and approval.

1.5.5 Mine Water

Ground water would be produced from the adits and mine void during the construction and mining periods. Inflow rates would vary as new fractures were encountered and drained but a steady state inflow of several hundred gallons per minute is expected. MMC intends to use water generated from the mine and adits in the mill circuit as makeup water. Currently, the MPDES permit at the Libby Adit that stipulates monitoring activities for mine water discharged via these approved outfalls. MMC would follow those permit monitoring requirements. Table C-8 shows the constituents and detection levels currently in place. Antimony, barium, beryllium, nickel, selenium, and thallium would be analyzed during the initial production year.

Water samples would be collected at the yard run-off pond. Adit and mine water would be "composited" on an hourly basis over a 24-hour period for all constituents except nitrate. Samples collected for nitrate analysis would be collected on a discreet basis because composite samples collected over 24 hours would likely exceed the 48-hour holding time for nitrate plus nitrite as N before the sample can be analyzed.

1.5.5.1 Process Water

Process water in the tailings impoundment would be sampled at the same time as the surface water sample collection frequency and following the constituent list developed for surface and ground water analyses. Seepage water collected by the underdrain system reporting to the Seepage Collection Pond and pumped back to the tailings impoundment would be sampled at the same frequency as the surface water samples and analyzed for the same parameter list.

1.5.6 Sample Frequency

Sampling from the yard run-off pond would be monthly or as specified in the MPDES permit when mine water was held in this facility. Other samples would be of sufficient frequency to determine actual average concentrations of the constituents shown in Table C-8, as determined by the DEQ.

Mine discreet samples during the first 6 months of construction would be collected and analyzed for nitrate plus nitrite as N and ammonia as N twice per month. During the next 6 months, sampling and analysis would alternate every month between every other day and twice a month.

If substantial inflows to the mine occur in the vicinity of Rock and St. Paul Lakes, MMC would report inflows to the lead agencies within 48 hours. Lake level data would be recorded continuously and included in regular reporting documents. Mine inflows would be sampled at the same frequency as the surface water samples and follow the same constituent list.

Table C-8. Proposed Monitoring Parameters and Detection Limits for Ground Water and Mine and Tailings Water.

Parameter (Non-metals)	Detection Limit (mg/L unless otherwise designated)	Parameter (Dissolved Metals)	Detection Limit (mg/L)
pHs.u.)	0.1	Aluminum	0.03
Dissolved Oxygen	0.1	*Antimony	0.003
Specific Conductivity (µS/cm)	1.0	Arsenic	0.001
Total dissolved solids	1.0	*Barium	0.005
Sodium	1.0	*Beryllium	0.001
Calcium	1.0	Cadmium	0.0001
Magnesium	1.0	Chromium	0.001
Potassium	1.0	Copper	0.001
Carbonate	1.0	Iron	0.01
Bicarbonate	1.0	Lead	0.003
Chloride	1.0	Manganese	0.005
Sulfate	1.0	Mercury	0.0001
Nitrate+Nitrite, as N	0.01	*Nickel	0.01
TKN	0.1	*Selenium	0.001
Total Phosphorus as P	0.005	Silver	0.003
Ortho-phosphate	0.005	*Thallium	0.001
Ammonia, as N	0.05	Zinc	0.001
Field Temperature			
Total Alkalinity (as $CaCO_3$)	1.0		
Total Hardness (as $CaCO_3$)	1.0		
Acrylamide†	0.01 or lowest possible		

*Mine and tailings water would be analyzed for antimony, barium, beryllium, nickel, selenium, and thallium in the first year of operations.
†In tailings impoundment water and ground water downgradient of the tailings impoundment.

1.5.6.1 Water Balance

MMC would maintain a water balance as part of the water resources monitoring effort. The detailed water balance would include inflows and outflows to the project facilities. The monitoring information would be used to modify, as necessary, operational water handling and to develop a post-mining water management plan. As part of this monitoring, MMC would measure:

- Daily mine and adit discharges
- The amount of tailings (coarse and fine) slurried to the impoundment and the percent solids of the slurry
- The amount and source of fresh makeup water used by the mill
- The amount of reclaimed process water (tailings impoundment) sent to the mill

- The amount of water collected by the seepage underdrain collections system and pumped back to the impoundment
- The amount and source of water sent to the dust suppression systems, if any
- The amount and source of water discharged to the LAD Areas, if any
- The amount and source of water discharged through the Libby Adit MPDES discharge permit
- Pan evaporation at impoundment site
- Evapotranspiration at the LAD Areas
- The amount of precipitation received at the tailings impoundment site and LAD Areas.

These measurements would be provided as monthly (or more frequently if requested by the lead agencies) and annual averages and totals in a quarterly hydrology report. If mine adit inflows greater than 1,200 gpm occur over a 2-month period or excessive tailings water occurs or was anticipated, MMC would notify the lead agencies within 2 weeks. MMC would then implement "excess water contingency plans." If the mine void encounters substantial ground water inflows in the vicinity of the Rock Lake Fault, MMC must notify the lead agencies within 10 business days and then must evaluate the possible connection to surface water bodies and provide an evaluation report to the lead agencies within 90 days after initial agency notification.

1.6 Plan Management

1.6.1 Quality Assurance/Quality Control

As part of each plan for environmental monitoring, MMC would develop quality assurance/quality control (QA/QC) procedures and submit them to the agencies for review and approval. Collectively, these procedures would compose a QA/QC plan that ensures the reliability and accuracy of monitoring information as it was acquired. QA/QC procedures would include both internal and external elements. Internal elements may include procedures for redundant sampling such as random blind splits or other replication schemes, chain of custody documentation, data logging, and error checking. External procedures may include audits and data analyses by outside specialists, and oversight monitoring and data checking conducted by the agencies.

Written reports to document the implementation of the QA/QC plan would be an integral part of monitoring reports. Any variances or exceptions to established sampling or data acquisition methods were detected during monitoring must be documented. Documentation would include a discussion of the significance of data omissions or errors, and measures taken to prevent any occurrences. Reports would be submitted to the appropriate agencies with the annual report, unless otherwise requested.

1.6.2 Sample Collection and Data Handling

Collection, storage and preservation of water samples would be in accordance with EPA procedures (EPA 1982). Grab samples would be collected from streams and ground water samples would be obtained using low flow sampling techniques. Samples would be cooled immediately after collection. Metals in water samples must be preserved by adding nitric acid in

the field to lower the pH to less than 2.0 or as appropriate to meet standard industry sampling protocols.

Ground water samples for metal analyses would be field filtered through a 0.45 micron filter to allow measurement of the dissolved constituents. Chemical analysis of water samples must be by procedures described in 40 CFR 136, EPA-0600/4-79-020, or methods shown to be equivalent. All field procedures must follow standard sampling protocols as demonstrated through the quality assurance and quality control documentation.

MMC would use a sample control plan, which includes 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. MMC would develop a master file of all field forms and laboratory correspondence. MMC would meet the laboratory method-required holding time for each constituent being analyzed.

MMC would ensure representativeness of samples collected by locating sampling stations in representative areas and by providing quality control samples and analyses. Quality control samples must include blind field standards, field cross-contamination blanks, and replicate samples. Field cross-contamination blanks would be inserted at a minimum frequency of 1 in 20. Blind field standards and field replicates would be inserted into the sample train at a minimum frequency of 1 in 20. In addition, MMC would use EPA-approved laboratories. If revised sampling methods or QA/QC protocols change, MMC would incorporate those as directed by the lead agencies.

1.6.3 Water Resource Data Reporting

Data (water quality and flow measurements) would be submitted to the reviewing agencies by MMC within 10 working days after receipt of final laboratory results. All monitoring data would be submitted to the lead agencies in an electronic format acceptable to the lead agencies. MMC would prepare a report briefly summarizing hydrologic information, sample analysis and quality assurance/quality control procedures following each sample interval. The report would be posted on MMC's website within 4 weeks after receipt of final laboratory results.

The annual report, summarizing data over the year, would include data tabulations, maps, cross-sections and diagram needed to describe hydrological conditions. Raw lab reports and field and lab quality results also would be reported. In the annual report, MMC would present a detailed evaluation of the data. Data would be analyzed using routine statistical analysis, such as analysis of variance, to determine if differences exist

- Between sampling stations
- Between an upstream reference station and the corresponding downstream station
- Between sampling time (monthly, growing season/non-growing season)
- Between stream flow at the time of sampling (for example, low flow during the fall compared to low flow during the winter)
- Between sampling years
- Trend analyses would be included where applicable and/or quantifiable.

The annual report would be posted on MMC's website within 90 days after receipt of the final laboratory results for the final quarter of the year. A formal review meeting would be arranged within 2 weeks of MMC submitting the monitoring report to the lead agencies. The formal review meeting would involve representatives from the reviewing agencies and MMC. The review could result in various outcomes:

- Determine that no change in the monitoring programs or mine operation plans was needed
- Require modifications to the monitoring programs
- Require new treatment or mitigation measures to be implemented as part of the mine project
- Require MMC to implement necessary measures to ensure compliance with applicable laws and regulations

2.0 Aquatic Biological Monitoring

2.1 General Requirements

MMC would conduct aquatic biological monitoring using locations, timing, and methods that are updated and expanded from those specified in Operating Permit 00150 and the 1993 KNF ROD. The modifications to the monitoring requirements would improve the ability to detect potential impacts of the project and meet all stream biology monitoring requirements for the full project.

MMC would conduct aquatic biological monitoring before, during, and after project construction and operation at stream stations that are within and downstream of project disturbance boundaries and at reference stations that are upstream of potential influence from the project. At replicate sample locations within each station, multiple parameters that are likely to display small-scale variability and likely to be correlated would be assessed. Replicated sample locations would be selected to be as similar as possible across stations. This sampling design would allow analysis of data using a before-after/control-impact approach, and would allow use of univariate and multivariate statistical methods. This sampling design is intended to identify natural variability and isolate the influence of water quality and fine sediment deposition on stream biota and habitat.

MMC would collect surface water quality samples at each aquatic biological monitoring station during each monitoring period to assist in interpretation of the data. MMC would also conduct salmonid population surveys and salmonid tissue chemistry surveys to provide additional information to assess the influence of the project on stream biota.

2.2 Monitoring Locations and Times

Depending on the alternative that is selected, MMC would conduct aquatic biological monitoring at up to 15 stations (Table C-9 (at the end of this document), Figure C-4). Ten stations are within or downstream of the proposed disturbance boundaries. Five stations, one for each stream in the project area, are upstream of potential project impacts and would serve as reference stations. Additional monitoring stations would be established in Rock Creek and East Fork Bull River if it is determined that the project has influenced water quality in these streams.

Monitoring frequency would vary, depending on the monitoring task and station (Table C-10). Most tasks would be conducted three times annually: prior to run-off from the higher elevations in the spring (typically April or May), during late-summer low flows (typically mid July to late August), and prior to ice formation (typically October). Other tasks would be conducted annually during the late-summer period, or less frequently as described below.

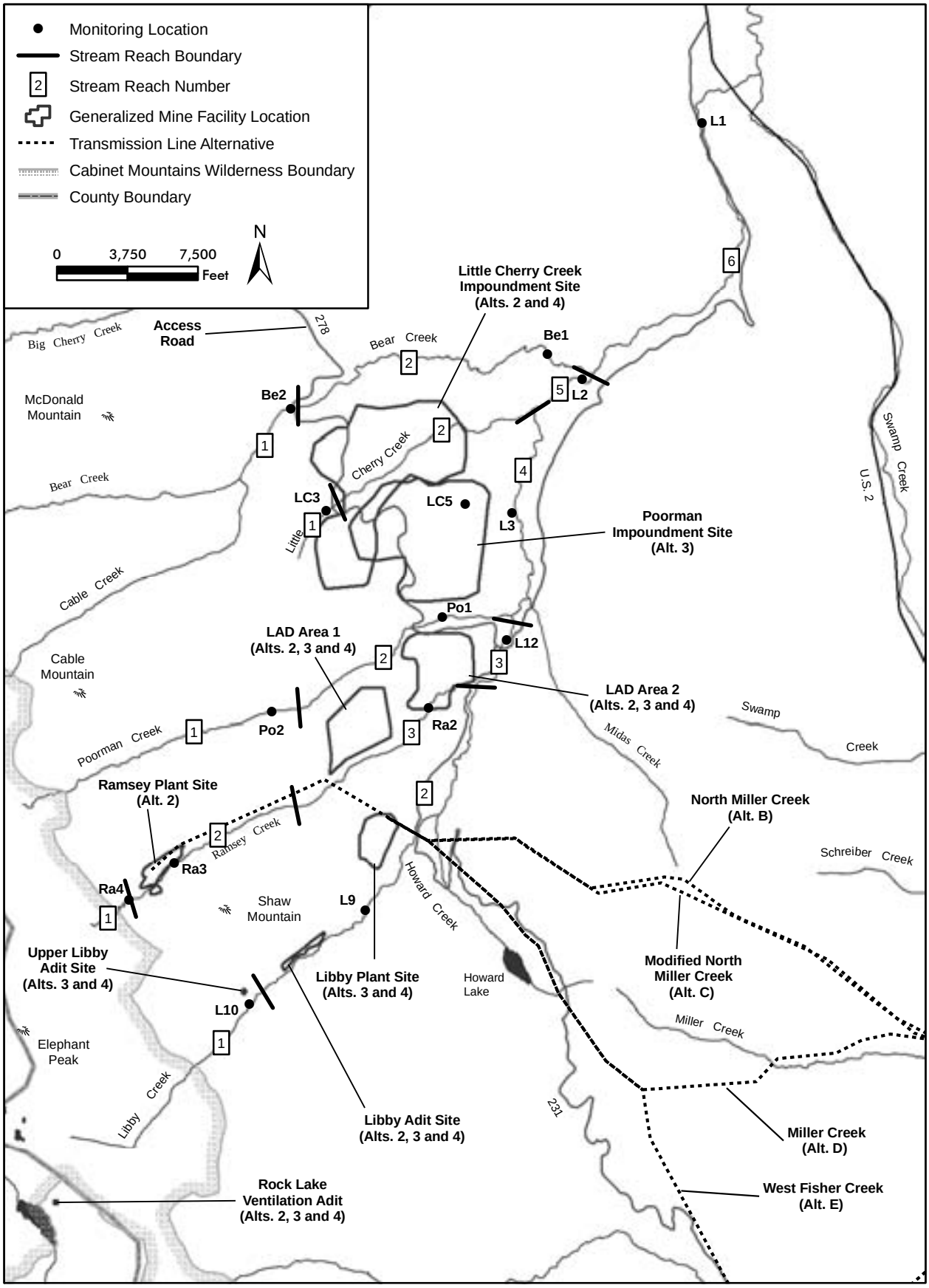


Figure C-4. Proposed Aquatic Biology Monitoring Locations

2.3 Substrate and Fine Sediments

MMC would document substrate characteristics and estimate fine sediment loading at all aquatic biological monitoring stations during all monitoring periods. Percent surface fines would be visually estimated using a grid sampling device as described in the R1/R4 methodology (Overton et al. 1997) at each quantitative macroinvertebrate sample (Surber sample) location. Embeddedness would be visually estimated at each Surber sample location using an embeddedness rating description (Platts et al. 1983). Substrate size distributions would be determined by conducting Wolman pebble counts of the substrate within each Surber sample (Wolman 1954).

At the five fish monitoring stations (L1, L3, L9, New LC5, and Be2, see below), the substrate monitoring methods described above would be supplemented with the McNeil Core substrate sampling method (based on Weaver and Fraley 1991). Ten representative core samples would be collected from potential spawning locations in scour pool tail crests and low-gradient riffles within the salmonid population survey reach at each of the four stations. Fewer core samples would be collected if 10 suitable locations are not located within the survey reach.

2.4 Habitat

Habitat surveys would be conducted annually in the late-summer concurrent with the fish monitoring surveys at Stations L1, L3, L9, New LC5, and Be2. Fish structures developed as mitigation also would be monitored. Instream habitat data collection would generally follow the R1/R4 methods developed by the FS (Overton et al. 1997). Habitat types within the stream reaches would be identified and measured individually. Measurements at recognized units within each habitat type would include length, wetted width, bank width, average depth, maximum depth, substrate type, type of bank vegetation, percent undercut bank, and percent eroded bank. These habitat measurements are consistent with the Inland Native Fish Strategy (INFS) goals. Additionally, other measurements, such as pool frequency, number of pieces of large woody debris, and lower bank angle, would be recorded to document further attainment of the riparian management objectives set by INFS (USDA Forest Service 1995).

2.5 Routine Physical/Chemical Features

MMC would measure the following routine physical and chemical parameters at all aquatic biological monitoring stations during all monitoring periods: stream discharge, air and water temperature, pH, total alkalinity, specific conductance, and sulfate. EPA approved methods or other acceptable methods specified in the monitoring plan would be used.

2.6 Benthic Macroinvertebrates

MMC would collect five quantitative samples and one qualitative sample of benthic macroinvertebrates from all aquatic biological monitoring stations during all monitoring periods. Methods used would generally follow the guidelines described in the DEQ's macroinvertebrate sampling protocol (2006) for the collection of quantitative Hess samples and semi-quantitative jab samples. Quantitative samples would be collected using a 500-micrometer mesh Surber sampler rather than a Hess net because Surber samplers have been used by the FWP in Libby Creek beginning in 2000 (Dunnigan et al. 2004. The continued use of the Surber sampler thus would allow for better comparisons with past data. Quantitative samples would be collected from

the riffle/run habitats in the stream. Specific sampling locations at each station would be standardized, to the extent possible, for depths between 0.5 and 1.0 feet and flow velocities of less than 1.5 feet per second. MMC would collect the qualitative jab sample with a 500-micrometer mesh kicknet in all micro-habitats not sampled during the collection of the quantitative samples, such as aquatic vegetation, snags, and bank margins. Benthic macroinvertebrates collected with the kicknet would be used to provide supplemental information on species composition at the sites and to determine the relative abundance of the taxa inhabiting aquatic habitats at the sampling station.

Parameters analyzed would include density, number of taxa, number of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) taxa, the EPT index, percent EPT individuals, Shannon-Weaver diversity index, Simpson diversity index, and the biotic condition index (BCI). Several of these parameters are among the metrics calculated by the DEQ as part of its data analysis (DEQ 1995; 2006), The use of other metrics such as evenness, Simpson's diversity index, and the BCI have been recommended by FS personnel to allow for comparisons with previously collected data within this region (Steve Wegner, personal communication, 2006). To summarize these data, four common statistical measures would be used (mean, standard deviation, coefficient of variation, and standard error of the mean), plus other appropriate measures (EPA 1990).

Quality assurance for macroinvertebrate data would be conducted randomly on 10 percent of the samples, with 95 percent agreement for taxonomic and count precision required. MMC also would maintain a permanent taxonomic reference collection that contains all benthic species collected from project area streams. Taxa identification in this collection would be documented and confirmed by a second taxonomist. This reference collection would be maintained by MMC through the period of post-operational monitoring. Following this period, the collection would be transferred to a depository selected by the agencies for permanent scientific reference.

2.7 Chlorophyll-a

MMC would sample periphyton at all aquatic biological monitoring stations concurrent with the proposed benthic macroinvertebrate population sampling. At each station, sample design, collection and analysis would follow DEQ's chlorophyll-a sampling protocol (2008). For diatoms, permanent slide mounts would be prepared. .MMC would prepare data reports that include lists of all taxa identified.

To provide quality control and quality assurance for these studies, MMC would maintain a permanent reference collection that contains representative samples of all dominant and any indicator taxa of periphyton collected from the monitoring stations. All such non-diatom taxa would be documented using digital photography and representative permanent slide mounts made for diatom taxa. Taxonomic identifications in the reference collection would be confirmed by a second taxonomist. This reference collection would be maintained by MMC through the period of post-operational monitoring. Following this period, the collection would be transferred to a depository selected by the agencies for a permanent scientific reference.

2.8 Salmonid Populations

To determine possible changes in salmonid populations associated with development of the Montanore Project, MMC would monitor salmonid populations in Libby Creek and Bear Creek annually during the late-summer sampling period. Salmonid population monitoring would be

conducted if the required permits were granted to MMC. If the required permits were not granted for some or all of the salmonid population monitoring, MMC would report the most relevant data that are available for the project area.

MMC would monitor salmonid populations in Libby Creek in three stream reaches (L1, L3, L9), the diverted Little Cherry Creek (new LC5), and Bear Creek (Be2) using the following procedures. The stream reach would be blocked by netting at its upstream and downstream limits to prevent fish movement into or out of the sample reach during the sampling. Sampling procedures would include multiple-pass depletion electroshocking to collect salmonids from a 300-yard (or 300-meter) reach of stream. All salmonids would be identified, measured for length, and released. Population densities of each salmonid species captured during the study would be estimated, where adequate sample sizes permit, using a maximum-likelihood model (e.g. Seber and Le Cren 1967, MicroFish 3.0). The condition of all captured salmonids would be recorded following an examination for overt signs of disease, parasites, or other indications of surface damage. Length-frequency data would be analyzed to determine whether species were naturally reproducing in or near the stream reaches. A monitoring report would be submitted annually to the KNF, the FWP and the DEQ.

The same salmonid monitoring procedures would be used to monitor salmonid response to fish mitigation projects implemented by MMC. Beginning in the year prior to a fish mitigation project, salmonid population density and biomass would be estimated using the approved methods. In subsequent years (yearly), the mitigation monitoring at each site would be repeated until there was evidence of a stable increase in salmonid populations at each site. The salmonid population data from stations L1 and Be2 would be used as controls to assess if observed changes were a natural event. Five consecutive years of data showing a positive response by salmonids would be required before MMC was credited for a mitigation project.

Similarly, MMC would monitor the recreational use levels at all fishery access sites that were modified for mitigation purposes. Beginning the year before, and extending at least 5 years after implementation, MMC would conduct creel surveys to show a stable increase in use by the targeted users of each access project.

2.9 Bioaccumulation of Metals in Fish Tissue

MMC would conduct monitoring studies that measure background concentrations of copper, cadmium, mercury, and lead in the fish in Libby Creek to provide a basis for comparison in order to document any potential changes in the concentrations of these metals due to construction and operation of the Montanore mine. Fish tissue monitoring would be conducted if the required permits were granted to MMC. If the required permits were not granted for some or all of the fish tissue monitoring, MMC would report the most relevant data that are available for the project area.

Prior to construction and once construction has begun, MMC would collect five rainbow trout or rainbow trout hybrids (*Oncorhynchus* sp.) annually from Sites L1, L3, and Be2 for a period of 5 years, with each trout collected being greater than 4 inches in size. Collections would be completed during the late-summer low-flow period, concurrent with the fish population surveys.

Homogenized whole-fish tissue samples would be analyzed to determine copper, cadmium, mercury and lead concentrations. Thereafter, if no increasing trends in metal concentrations have

been identified, MMC would resample each site at a 3-year interval to document any trends in bioaccumulation of these metals. Test procedures would be the same as those used for baseline testing, unless changed by the agencies.

2.10 Sampling Trip and Annual Reporting

Within one week of completing biological sampling, MMC would submit a brief report to appropriate review personnel in the DEQ, the KNF, and the FWP. This report would include brief statements about stream conditions observed at each monitoring station and would alert the review personnel to any marked changes in monitoring data relative to the cumulative monitoring record.

On or before March 1 of each year, MMC would submit an annual aquatic monitoring report that contains summaries of all aquatic monitoring data collected during the previous year. Each report also would discuss trends in population patterns and evaluate changes in stream habitat quality, based on all data collected to date for the project. Reference to appropriate scientific literature would be included. Recommendations in these reports can include modifications to increase monitoring efficiency or to provide additional data needs.

2.11 Annual Review and Possible Revision of the Monitoring Plan

Within one month after MMC submits the annual report, an annual meeting would be held to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan. This meeting would include personnel from the DEQ, KNF, FWP, MMC's representatives, and other interested individuals.

3.0 References

Dunnigan, J., J. DeShazer, L. Garrow, T. Ostrowski, and B. Marotz. 2004. Mitigation for the construction of the Libby dam, Annual Report 2003. Montana Fish, Wildlife, and Parks, Libby, MT.

Environmental Protection Agency. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029. Cincinnati, OH.

Environmental Protection Agency. 1990. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters. Office of Research and Development. EOA 600/4-90/030. Cincinnati, OH.

Environmental Protection Agency. 1997. Region VIII NPDES whole effluent toxics control program. August. Denver, CO.

Environmental Protection Agency. 2002. Methods for Measuring Acute Toxicity of Effluent to Freshwater and Marine Organisms. 5th Edition. EPC-821-R-02-012. Office of Water, Washington, D.C.

Environmental Protection Agency. 2007a. Guidelines Establishing Test Procedures for the Analysis of Pollutants. 40 CFR Part 136. http://ecfr.gpoaccess.gov.

Environmental Protection Agency. 2007b. Survey of the Nation's Lakes. Field Operations Manual. EPA 841-B-07-004. Washington, D.C.

MicroFish 3.0 software. P.O. Box 52012, Durham, NC 27717. (509) 993-0722. www.microfish.org.

Montana Department of Environmental Quality. 2006. Sample Collection, Sorting, and Taxonomic Identification of Benthic Macroinvertebrates. Standard Operation Procedure W!PBWQM-009. Water Quality Planning Bureau, Helena, MT. Accessed at: http://www.deq.mt.gov/wqinfo/QAProgram/WQPBWQM-009rev2_final_web.pdf

Montana Department of Environmental Quality. 2008. Sample Collection and Laboratory Analysis of Chlorophyll-a. Standard Operation Procedure WQPBWQM-011. Water Quality Planning Bureau, Helena, MT. Accessed at: http://www.deq.mt.gov/wqinfo/QAProgram/SOP%20WQPBWQM-011v4_final.pdf

Overton, C.C., S.P. Woolrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook. General Technical Report Int-GTR-346. U.S. Department of Agriculture, Ogden, UT.

Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah.

Seber, G.A.F. and E.D. Le Cren. 1967. Estimating population parameters from catches large relative to the population. Journal of Animal Ecology 36(3):631-643.

USDA Forest Service. 1995. Inland Native Fish Strategy Environmental Assessment: Decision Notice and Finding of No Significant Impact. Intermountain, Northern, and Pacific Northwest Regions.

USDA Forest Service. 2001. Field Guide for Surface Water Sample and Data Collection. USDA Forest Service Air Program. J.T. Turk.

USDA Forest Service. 2006a. Project LAKES: Long-Term Water Quality Monitoring and Zooplankton Data Collection Protocol. USDA Forest Service Pacific Southwest Region. June 2004, revised May.

USDA Forest Service. 2006b. Project LAKES: Long-Term Synoptic Water Quality Data Collection Protocol. USDA Forest Service Pacific Southwest Region.

Weaver, T. and J. Fraley. 1991. Fisheries Habitat and Fish Populations. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program. Flathead Basin Commission. Kalispell, Montana.

Wolman, M.G. 1954. A method of sampling coarse river-bed gravel. Transactions of American Geophysical Union 35:951-956.

Table C-9. Aquatic Biology Monitoring Stations.

Reach	Nearest Upstream Activities	Station ID (surface water ID)	Station Comments	Alter-native	All non-fish monitoring, spring, late-summer, fall	Fish population and habitat, late-summer	Fish tissue metals, late-summer
Ramsey Creek							
1	none	Ra4 (RA-100)	Upstream reference	2	X		
2	Ramsey Plant Site and Adits, tailings lines, bridge and transmission line	Ra3 (RA-200)	Impact assessment for activities in upper Ramsey Creek. The nearest suitable habitat downstream of of the upper Ramsey Creek disturbance boundary would be monitored.	2	X		
3	LAD 1 and 2, tailings line, access raod	Ra2 (RA-550)	Integrated impact assessment for activities in upper and lower Ramsey Creek.	All	X		
Poorman Creek							
1	none	Po2 (PM-500)	Upstream reference	All	X		
2	LAD 1 and 2, tailings line and road	Po1 (PM-1000)	Impact assessment. Po1 located downstream of the FS 6212 bridge.	All	X		
Little Cherry Creek/Former Little Cherry Creek							
1	none	LC3 (LC-100)	Upstream reference; site would be upstream of NFS road #278	2 and 4	X		
2	Tailings Impoundment facilities	LC1 (LC-800)	Impact assessment	2 and 4	X		
	Tailings Impoundment facilities	New LC5	Impact assessment. Site would be in suitable habitat in Diversion Channel	2 and 4	X	X	X

Reach	Nearest Upstream Activities	Station ID (surface water ID)	Station Comments	Alter-native	All non-fish monitoring, spring, late-summer, fall	Fish population and habitat, late-summer	Fish tissue metals, late-summer
Bear Creek							
1	none	Be2 (BC-500)	Upstream reference	2	X	X	X
2	Impoundment surface runoff	Be1 (BC - 100)	Impact assessment at closure only	2	X		
Libby Creek							
1	none	L10 (LB-200)	Upstream reference; upstream of Upper Libby Adit	All	X		
2	Libby Adit facilities	L9 (LB-300)	Impact assessment	All	X	X	
3	LAD 2	L12	Integrated impact assessment	All	X		
4	LAD 2	L3 (LB1000)	Integrated impact assessment	All	X	X	X
5	Impoundment	L2 (LB-2000)	Integrated impact assessment	All	X		
6	All	L1 (LB-3000)	Integrated impact assessment	All	X	X	X

Table C-10. Aquatic Biology Monitoring Tasks.

Task category	Task	Timing			Number of stations	Method	Replication per station and within-station locations
		Spring	Late-summer	Fall			
Benthic Biota	Macroinvertebrates, quantitative	X	X	X	all	Surber samples for lab taxonomy	5 sites with most similar microhabitat near station
	Macroinvertebrates, qualitative	X	X	X	all	kicknet sample for lab taxonomy	1 sample from all habitats in 100 ft reach that includes Surber sample locations
	Periphyton, quantitative	X	X	X	all	biomass samples for spectrophotometric determination	at each of the 5 Surber sites
	Periphyton, qualitative	X	X	X	all	picking and scraping all varieties for lab taxonomy	In accordance with DEQ SOP
Habitat	Canopy cover	X	X	X	all	densiometer	at each of the 5 Surber sites
	Water velocity	X	X	X	all	flow meter at 0.6 m depth	at each of the 5 Surber sites
	Stream discharge	X	X	X	all	velocity-area principle / 0.6 m depth	1 transect at station
	Fish habitat survey		X		4	R1/R4	same 100 yd reach as salmonid survey
Substrate	Embeddedness	X	X	X	all	visual categorical scale	at each of the 5 Surber sites
	Substrate size distribution	X	X	X	all	Wolman count	surrounding and including each of the 5 Surber sites
	Surface fines	X	X	X	all	49 point grid	at each of the 5 Surber sites
	Spawning gravel		X		4	McNeil cores for lab analysis and field settling cone	maximum obtainable up to 10 samples within 100 yd salmonid survey reach
Water Quality	Conductivity	X	X	X	all	meter	at each of the 5 Surber sites
	pH	X	X	X	all	meter	at each of the 5 Surber sites
	Water temperature	X	X	X	all	meter	at each of the 5 Surber sites
	Water chemistry sample	X	X	X	all	grab sample for comprehensive lab analysis	1 sample at station
Fish	Salmonid population survey		X		4	multiple-pass electrofishing	extending from station to 100 yd upstream
	Salmonid tissue metals samples		X		3	*Oncorhynchus* sp. whole-fish Cu, Cd, Hg, Pb	5 fish from population survey

Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line

STATE OF MONTANA/USDA FOREST SERVICE
ENVIRONMENTAL SPECIFICATIONS FOR MONTANORE 230-KV TRANSMISSION LINE

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DEFINITIONS

ACCESS EASEMENT:	Any land area over which the OWNER has received an easement from a LANDOWNER allowing travel to and from the project. Access easements may or may not include access roads.
ACCESS ROAD:	Any travel course which is constructed by substantial recontouring of land and which is intended to permit passage by most four-wheeled vehicles.
ARM:	Administrative Riles of Montana
BEGINNING OF CONSTRUCTION:	Any project-related earthmoving or removal of vegetation (except for clearing of survey lines).
BOARD:	Montana Board of Environmental Review
CFR	Code of Federal Regulations
CONTRACTOR:	Constructors of the Facility (agent of owner)
DAY	Monday through Friday, excluding all state or federal holidays
DEQ:	Montana Department of Environmental Quality
DNRC:	Montana Department of Natural Resources and Conservation
FWP:	Montana Fish, Wildlife, and Parks
EXEMPT FACILITY:	A facility meeting the requirements of 75-20-202, MCA and accompanying rules.
FS:	United States Department of Agriculture, Forest Service
KNF:	Kootenai National Forest
LANDOWNER:	The owner of private property
MCA	Montana Code Annotated
MDT	Montana Department of Transportation
NFSL:	National Forest System Lands
OWNER:	The owner(s) of the facility, or the owner's agent.

ROD: Record of Decision

SENSITIVE AREA: Area which exhibits environmental characteristics that may make them susceptible to impact from construction of a transmission facility. The extent of these areas is defined for each project and may include any of the areas listed in Circular MFSA-2, Sections 3.2(1)(d) and 3.4(1).

SHPO: State Historic Preservation Office

SPECIAL USE SITES: All locations other than structure locations and roads needed for the construction, operation, and decommissioning of the transmission line, and shall include, but not be limited to, staging areas, helicopter landing and fueling sites, pulling and tensioning sites, stockpile sites, splicing sites, borrow pits, construction campsites, and storage or other building sites.

INTRODUCTION

The purpose of these specifications is to ensure mitigation of potential environmental impacts during the construction and interim reclamation of the 230-kV transmission facility associated with the proposed Montanore Project. These specifications do not apply to the Sedlak Park substation, loop line, buried 34.5-kV powerline associated with the Montanore Mine, or to the mine itself. All other mine-related disturbances are covered by a Montana Department of Environmental Quality (DEQ) hard rock operating permit and Forest Service (FS) Plan of Operations. These specifications vary from those typically prepared by DEQ for other transmission line facilities because the specifications also incorporate FS requirements. These specifications are intended to be incorporated into the texts of contracts, plans, Plan of Operations, and specifications.

Decommissioning of the transmission line will be covered by the final reclamation and closure plan described in Appendix at the end of this document.

For non-exempt facilities, the Montana Major Facility Siting Act supersedes all state and local government environmental permit requirements. DEQ, however, returns the authority to determine compliance of the proposal facility with state and federal standards for air and water quality standards. State laws for the protection of employees engaged in the construction, operation on maintenance of the proposal facility also remain in effect (Section 75-20-401, MCA).

Appendices at the end of these specifications refer to individual topics of concern and to site-specific concerns. Certain of these Appendices, will be prepared by the OWNER working in consultation with DEQ and FS prior to the start of construction and submitted for approval by the DEQ and FS. Other Appendices will be prepared by the DEQ and FS at the time a decision is made whether to approve the project.

GENERAL SPECIFICATIONS

0.1. SCOPE

These specifications apply to all lands affected by the 230-kV transmission line, excluding the Sedlak Substation and loop line and the 34.5-kV power line. As provided in ARM 17.20.1902 (10), the certificate holder may contract with the property owner for revegetation or reclamation if the property owner wants different reclamation standards from (10) (a) applied on the property and that not reclaiming to the standards specified in (10)(a) and (b) would not have adverse impacts on the public and other landowners. Where the LANDOWNER requests practices other than those listed in these specifications, DEQ may authorize such a change provided that the STATE INSPECTOR is notified in writing of the change and that the change will not be in violation of: (1) the Certificate; (2) any conditions imposed by the DEQ or (3) the DEQ's finding of minimum adverse impact; (4) the regulations in ARM 17.20.1701 through 17.20.1706, 17.20.1901, and 17.20.1902.

On private land, these specifications shall be enforced by the STATE INSPECTOR. On NFSL, enforcement shall be the joint responsibility of the STATE INSPECTOR and the KNF INSPECTOR.

0.2. ENVIRONMENTAL PROTECTION

The OWNER shall conduct all operations in a manner to protect the quality of the environment.

0.3. CONTRACT DOCUMENTS

It is the OWNER'S responsibility to ensure compliance with these specifications. If appropriate, these specifications can be part of or incorporated into contract documents to ensure compliance; in any case, the OWNER is responsible for its agent's adherence to these specifications in performing the work.

0.4. BRIEFING OF EMPLOYEES

The OWNER shall ensure that the CONTRACTOR and all field supervisors are provided with a copy of these specifications and informed of the applicability of individual sections to specific procedures. It is the responsibility of the OWNER to ensure its CONTRACTOR and CONTRACTOR's Construction Supervisors comply with these measures. The OWNER'S Project Supervisor shall ensure all employees are informed of the applicable environmental specifications discussed herein prior to and during construction. Site-specific measures provided in the appendices attached hereto shall be incorporated into the design and construction specifications or other appropriate contract document. The OWNER shall have regular contact and site supervision to ensure compliance is maintained.

0.5. COMPLIANCE WITH REGULATIONS

All project-related activities of the OWNER shall comply with all applicable local, state, and federal laws, regulations, and requirements that are not superseded by the Major Facility Siting Act.

0.6. LIMITS OF LIABILITY

The OWNER is not responsible for correction of environmental damage or destruction of property caused by negligent acts of DEQ or FS employees during construction, operation maintenance, decommissioning, and reclamation of the proposal project.

0.7. DESIGNATION OF SENSITIVE AREAS

DEQ and FS, in their evaluation of the transmission line, have designated certain areas along the right-of-way or access roads as SENSITIVE AREAS as indicated in Appendix A. The OWNER shall take all reasonable actions including the measures listed in Appendix Ato avoid adverse impacts in these SENSITIVE AREAS.

0.8. PERFORMANCE BONDS

To ensure compliance with these specifications, prior to any ground disturbing activity, the OWNER shall submit a BOND ("TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND") to the State of Montana or its authorized agent pertaining specifically to the reclamation of designated access roads, special use areas, and adjacent land disturbed during construction (Appendix B). The TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND shall be held to ensure cleanup and construction reclamation are complete and revegetation is proceeding satisfactory. At the time cleanup and construction reclamation are complete and revegetation is proceeding satisfactory, the OWNER shall be released from its obligation for transmission line construction reclamation and the TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND shall be released.

Concurrently, the OWNER shall submit a separate BOND ("JOINT DECOMMISSIONING BOND") to the DEQ and FS pertaining specifically to monitoring, decommissioning of the transmission line and reclamation follow decommissioning. The JOINT DECOMMISSIONING BOND shall be subject to the FS and DEQ bond release provisions as outlined in the Reclamation Plan approved by the FS and DEQ. The approved Reclamation Plan shall contain reclamation standards as stringent as those found in ARM 17.20.1902(10).

0.9. DESIGNATION OF STRUCTURES

Each structure for the transmission line shall be designated by a unique number on plan and profile maps and referenced consistently. Any reference to specific poles or structures in the Appendices shall use these numbers. If this information is not available because the survey is not complete, station numbers or mileposts shall indicate locations along the centerline. Station numbers or mileposts of all angle points shall be designated on plan and profile maps.

0.10. ACCESS

When easements for construction access are obtained for construction personnel, provision shall be made by the OWNER to ensure that DEQ will be allowed access to the special use areas, right-of-way, and to any off-right-of-way access roads. Where such easements are obtained on private land to provide access to NFSL, such provisions shall also be made for the KNF INSPECTOR. Liability for damage caused by providing such access for the STATE INSPECTOR or KNF INSPECTOR shall be limited by section 0.6 LIMITS OF LIABILITY.

0.11. DESIGNATION OF STATE INSPECTOR AND KNF INSPECTOR

DEQ shall designate a STATE INSPECTOR or INSPECTORS to monitor the OWNER'S compliance with these specifications and any other project–specific mitigation measures adopted by DEQ as provided in ARM 17.20.1901 through 17.20.1902. The FS shall designate a KNF INSPECTOR or INSPECTORS to monitor the OWNER'S compliance with the Plan of Operations for activities on NFSL. The STATE INSPECTOR shall be the OWNER's liaison with the State of Montana on construction, post-construction, and construction reclamation activities for the certified transmission line on all state and private lands. The KNF INSPECTOR and the STATE INSPECTOR shall coordinate lead roles for construction, post-construction, and reclamation activities for the certified transmission line on NFSL. All communications regarding the project shall be directed to the STATE INSPECTOR and on NFSL, to the KNF INSPECTOR and STATE INSPECTOR. The names of the INSPECTORS are in Appendix C.

1.0. PRECONSTRUCTION PLANNING AND COORDINATION

1.1. PLANNING

1.1.1. Planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts shall be kept to a minimum. The CONTRACTOR and OWNER shall, to the extent possible, plan the timing of construction, construction and maintenance access requirements, location of special use areas, and other details before the commencement of construction.

1.1.2. At least 45 days before the start of construction, the OWNER shall submit plan and profile map(s), both on paper and an electronic equivalent agreed to by the DEQ and FS, to DEQ and the FS depicting the location of the centerline and of all construction access roads, maintenance access roads, structures, clearing back lines, and, to the extent known, special use sites. The scale of the map shall be 1:24,000 or larger. Specifications and typical sections for construction and maintenance access roads shall be submitted with the plan and profile maps(s). When these materials are submitted, access road locations shall have been flagged on the ground for review by the KNF and STATE INSPECTORS.

1.1.3. At least 45 days before the start of construction, constructing or reconstructing roads, the OWNER shall submit a Road Management Plan to the FS and DEQ. This plan shall detail the specific location of all roads that need to be opened, constructed, or reconstructed. The OWNER must receive written approval of the plan from the FS and DEQ prior to gaining access on any

closed road or beginning any surface disturbing activity. This plan, once approved, shall be incorporated into Appendix D.

1.1.4. If special use areas are not known at the time of submission of the plan and profile, the following information shall be submitted no later than 5 days prior to the start of construction. The location of special use areas shall be plotted on one of the following and submitted to the KNF and STATE INSPECTORS: ortho-photomosaics of a scale 1:24,000 or larger, or available USGS 7.5' plan and profile maps of a scale 1:24,000 or larger, and an electronic equivalent agreed to by the DEQ and FS.

1.1.5. Changes or updates to the information submitted in 1.1.2 through 1.1.4 shall be submitted to the DEQ and FS for approval as they become available. In no case shall a change be submitted less than 5 days prior to its anticipated date of construction. Where changes affect designated SENSITIVE AREAS, these changes must be submitted to DEQ and FS 15 days before construction and approved by the STATE INSPECTOR on all lands and the KNF on FS lands prior to construction.

1.2. PRECONSTRUCTION CONFERENCE

1.2.1. At least one week before commencement of any construction activities, the OWNER shall schedule a preconstruction conference with DEQ and the FS. The KNF and STATE INSPECTORS shall be notified of the date and location for this meeting

1.2.2. The OWNER's representative, the CONTRACTOR's representative, the designated INSPECTORS, and representatives of affected state and federal agencies who have land management or permit and easement responsibilities shall be invited to attend the preconstruction conference.

1.3. PUBLIC CONTACT

1.3.1. Written notification by the OWNER's field representative or the CONTRACTOR shall be given to local public officials in each affected community prior to the beginning of construction to provide information on the temporary increase in population, when the increase is expected, and where the workers will be stationed. If local officials require further information, the OWNER shall hold meetings to discuss potential temporary changes. Officials contacted shall include the county commissioners, city administrators, and law enforcement officials. It is also suggested that local fire departments, emergency service providers, and a representative of the Chamber of Commerce be contacted.

1.3.2. The OWNER shall negotiate with the LANDOWNER in determining the best location for access easements and the need for gates.

1.3.3. The OWNER shall contact local government officials, MDT, or the managing agency, as appropriate, regarding implementation of required traffic safety measures.

1.4. PRECONSTRUCTION SURVEYS

1.4.1. The OWNER shall complete prior to construction an archaeological survey of all NFSL proposed for surface disturbance associated with transmission line construction. A similar survey on private land shall be coordinated with the LANDOWNER and be completed, if allowed by the LANDOWNER, before any land-disturbing activities occur. In addition, the OWNER shall develop a plan approved by the DEQ and FS that includes steps to be taken when sites are discovered during construction activities and describes the measures to be taken to identify, evaluate, and avoid or mitigate damage to cultural resources affected by the project. The plan (Appendix E) shall include: (1) actions taken to identify cultural resources during initial intensive survey work; (2) an evaluation of the significance of the identified sites and likely impacts caused by the project; (3) recommended treatments or measures to avoid or mitigate damage to known cultural sites; (4) steps to be taken in the event other sites are identified after approval of the plan; and (5) provisions for monitoring construction to protect cultural resources. Except for monitoring, all steps of the plan must be carried out prior to the start of construction in an area. The requirements for this plan should not be construed to exempt or alter compliance by the OWNER or managing agency with 36 CFR 800. However, compliance with 36 CFR 800 can be used to satisfy the requirements included in this section.

1.4.2. The OWNER shall complete a survey for threatened, endangered, or Forest sensitive plant species on NFSL for any areas where such surveys have not been completed and that will be disturbed by transmission line construction. Similarly, the OWNER, in coordination with the LANDOWNER, and if allowed by the LANDOWNER, shall conduct surveys in habitat suitable for threatened, endangered, and state-listed plant species potentially occurring on non-NFSL lands. The surveys shall be submitted to the DEQ and FS for approval. If adverse effects could not be avoided, OWNER shall develop appropriate mitigation plans for agency approval. The mitigation shall be implemented before any ground-disturbing activities.

1.4.3. The OWNER shall complete a jurisdictional wetland delineation of all areas proposed for ground disturbance associated with the transmission line, including all stream crossings by roads. The surveys would be submitted to the DEQ and FS for approval. If adverse effects could not be avoided, OWNER shall develop appropriate mitigation plans for agency approval. The mitigation shall be implemented before any ground-disturbing activities.

2.0 CONSTRUCTION

2.1. GENERAL

2.1.1. The preservation of the natural landscape contours and environmental features shall be an important consideration in the location of all construction facilities, including roads and special use areas. Construction of these facilities shall be planned and conducted so as to minimize destruction, scarring, or defacing of the natural vegetation and landscape. Any necessary earthmoving shall be planned and designed to be as compatible as possible with natural landforms.

2.1.2. Temporary special use areas shall be the minimum size necessary to perform the work. Such areas shall be located where most environmentally compatible, considering slope, fragile soils or vegetation, and risk of erosion. After construction, these areas shall be reclaimed as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the STATE INSPECTOR. On NFSL, these areas shall be reclaimed as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the KNF and STATE INSPECTORS.

2.1.3. All work areas shall be maintained in a neat, clean, and sanitary condition at all times. Trash or construction debris (in addition to solid wastes described in section 2.14) shall be regularly removed during the construction and reclamation periods.

2.1.4. In areas where mixing of soil horizons will lead to a significant reduction in soil productivity, increased difficulty in establishing permanent vegetation, or an increase in weeds, mixing of soil horizons shall be avoided insofar as possible. This may be done by removing and stockpiling topsoil, where practical, so that it may be spread over subsoil during site reclamation.

2.1.5. Vegetation such as trees, plants, shrubs, and grass on or adjacent to the right-of-way that does not interfere with the performance of construction work or operation of the line itself shall be preserved. The Vegetation Removal and Disposition Plan (Appendix F) shall identify the specific areas where vegetation will be removed or retained to minimize impacts from the construction and operation of the transmission line. This plan must be approved by the inspectors in their areas of jurisdiction prior to construction.

2.1.6. The OWNER shall take all necessary actions to avoid adverse impacts to SENSITIVE AREAS listed in Appendix A and implement the measures listed in Appendix A in these areas. The STATE INSPECTOR shall be notified 5 days in advance of initial clearing or construction activity in these areas. In addition the KNF INSPECTOR shall be notified 5 days in advance of initial clearing or construction activity on NFSL in these areas. The OWNER shall mark or flag the clearing backlines and limits of disturbance in certain SENSITIVE AREAS as designated in Appendix A. All construction activities must be conducted within this marked area.

2.1.7. The OWNER shall either acquire appropriate land rights or provide compensation for damage for the land area disturbed by construction. The width of the area disturbed by construction shall not exceed a reasonable distance from the centerline as necessary to perform the work. For this project, construction activities except access road construction and use of special use areas shall be contained within the area specified in Appendix G.

2.1.8. Flow in a stream course may not be permanently diverted. If temporary diversion is necessary for culvert installation, flow shall be restored immediately after culvert installation, as determined by the STATE INSPECTOR on all lands, and KNF INSPECTOR on NFSL.

2.2. CONSTRUCTION MONITORING

2.2.1. The STATE INSPECTOR is responsible for implementing the compliance monitoring required by ARM 17.20.1902. The STATE and KNF INSPECTORS are responsible for

implementing the compliance monitoring on NFSL. The plan specifies the type of monitoring data and activities required and terms and schedules of monitoring data collection, and assigns responsibilities for data collection, inspection reporting, and other monitoring activities. It is attached as Appendix H.

2.2.2. The INSPECTORS, the OWNER, and the OWNER'S agents shall attempt to rely upon a cooperative working relationship to reconcile potential problems relating to construction in SENSITIVE AREAS and compliance with these specifications. When construction activities cause excessive environmental impacts due to seasonal field conditions or damage to sensitive features, the designated INSPECTORS shall talk with the OWNER about possible mitigating measures or minor construction rescheduling to avoid these impacts and may impose additional mitigating measures. The INSPECTORS shall be prepared to provide the OWNER with written documentation of the reasons for the additional mitigating measures within 24 hours of their imposition. All parties shall attempt to adequately identify and address these areas and planned mitigation, to the extent practicable, during final design to minimize conflicts and delays during construction activities.

2.2.3. The INSPECTORS may require mitigating measures or procedures at some sites beyond those listed in Appendix A in order to minimize environmental damage due to unique circumstances that arise during construction, such as unanticipated discovery of a cultural site. The KNF INSPECTOR may require additional mitigating measures on NFSL. The INSPECTORS shall follow procedures described in the monitoring plan when such situations arise.

2.2.4. In the event that the STATE INSPECTOR shows reasonable cause that compliance with these specifications is not being achieved, and the OWNER has not taken reasonable efforts to remediate the situation, DEQ shall take corrective action as described in 75-20-408, MCA. In the event that the KNF INSPECTOR shows reasonable cause that compliance with these specifications is not being achieved, FS shall implement measures described in 36 CFR 228.7(b).

2.3. TIMING OF CONSTRUCTION

2.3.1. Construction and motorized travel may be restricted or prohibited at certain times of the year in certain areas. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if the OWNER can clearly demonstrate that no significant environmental impacts will occur as a result. These areas are listed in Appendix I.

2.3.2. In order to prevent rutting and excessive damage to vegetation, construction will not take place during periods of high soil moisture when construction vehicles will cause severe rutting deeper than 4 inches requiring extensive reclamation.

2.4. PUBLIC SAFETY

2.4.1. All construction activities shall be done in compliance with existing health and safety laws.

2.4.2. Requirements for aeronautical hazard marking shall be determined by the OWNER in consultation with the Montana Aeronautical Division, the FAA, and the DEQ, and FS. These requirements are listed in Appendix J. Where required, aeronautical hazard markings shall be installed at the time the wires are strung, according to the specifications listed in Appendix J.

2.4.3. Noise levels shall not exceed established DEQ standards as a result of operation of the facility and associated facilities. For electric transmission facilities, the average annual noise levels, as expressed by an A-weighted day-night scale (Ldn) shall not exceed 50 decibels at the edge of the right-of-way in residential and subdivided areas unless the affected LANDOWNER waives this condition.

2.4.4. The facility shall be designed, constructed, and operated to adhere to the National Electrical Safety Code regarding transmission lines.

2.4.5. The electric field at the edge of the right-of-way shall not exceed 1 kilovolt per meter measured 1 meter above the ground in residential or subdivided areas unless the affected LANDOWNER waives this condition, and that the electric field at road crossings under the facility shall not exceed 7 kilovolts per meter measured 1 meter above the ground.

2.5. PROTECTION OF PROPERTY

2.5.1. Construction operations shall not take place over or upon the right-of-way of any railroad, public road, public trail, or other public property until negotiations and/or necessary approvals have been completed with the LANDOWNER or FS, and on lands subject to a conservation easement, FWP. Designated roads and trails as listed in Appendix A and Appendix D shall be protected and kept open for public use. Where it is necessary to cross a trail with access roads, the trail corridor shall be restored. Adequate signing and/or blazes shall be established so the user can find the route. All roads and trails designated by any government agency as needed for fire protection or other purposes shall be kept free of logs, brush, and debris resulting from operations under this agreement. Any such road or trail damaged by project construction or maintenance shall be promptly restored to its original condition.

2.5.2. Reasonable precautions shall be taken to protect, in place, all public land monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, the marker shall be reestablished and referenced in accordance with the procedures outlined in the “Manual of Instruction for the Survey of the Public Land of the United States” or, in the case of private property, the specifications of the county engineer. Reestablishment of survey markers shall be at the expense of the OWNER.

2.5.3. Construction shall be conducted so as to prevent any damage to existing real property including transmission lines, distribution lines, telephone lines, railroads, ditches, and public roads crossed. If such property is damaged during construction, operation, or decommissioning, the OWNER shall repair such damage immediately to a reasonably satisfactory condition in consultation with the property owner. The LANDOWNER shall be compensated for any losses to personal property due to construction, operation, or decommissioning activities.

2.5.4. In areas with livestock, the OWNER shall make a reasonable effort to comply with the reasonable requests of LANDOWNERS regarding measures to control livestock. Unless requested by a LANDOWNER, care shall be taken to ensure that all gates are closed after entry or exit. Gates shall be inspected and repaired when necessary during construction and missing padlocks shall be replaced. The OWNER shall ensure that gates are not left open at night or during periods of no construction activity unless other requests are made by the LANDOWNER. Any fencing or gates cut, removed, damaged, or destroyed by the OWNER shall immediately be replaced with new materials. Fences installed shall be of the same height and general type as the fence replaced or nearby fence on the same property, and shall be stretched tight with a fence stretcher before stapling or securing to the fence post. Temporary gates shall be of sufficiently high quality to withstand repeated opening and closing during construction, to the satisfaction of the LANDOWNER.

2.5.5. The OWNER must notify the STATE INSPECTOR, KNF INSPECTOR and, if possible, the affected LANDOWNER within 2 days of damage to land, crops, property, or irrigation facilities, contamination or degradation of water, or livestock injury caused by the CONTRACTOR and/or the OWNER's activities, and the OWNER shall reasonably restore any damaged resource and/or replace where applicable damaged property. The OWNER shall provide reasonable compensation for damages to the affected landowner.

2.5.6. Pole holes and anchor holes must be covered or fenced in any fields, pastures, or ranges being used for livestock grazing or where a LANDOWNER's requests can be reasonably accommodated.

2.5.7. When requested by the LANDOWNER, all fences crossed by permanent access roads shall be provided with a gate. All fences to be crossed by access roads shall be braced before the fence is cut. Fences not to be gated should be restrung temporarily during construction and restrung permanently within 30 days following construction, subject to the reasonable desires of the LANDOWNER.

2.5.8. Where new access roads cross fence lines, the OWNER shall make reasonable effort to accommodate the LANDOWNER's wishes on gate location and width.

2.5.9. Any breaching of natural barriers to livestock movement by construction activities shall require fencing sufficient to control livestock.

2.6. TRAFFIC CONTROL

2.6.1. At least 30 days before any construction within or over any state or federal highway right-of-way or paved secondary highway for which MDT has maintenance, the OWNER shall notify the appropriate MDT field office to review the proposed occupancy and to obtain appropriate permits and authorizations. The OWNER must supply DEQ and FS with documentation that this consultation has occurred. This documentation shall include any measures recommended by MDT that apply to state highways and to what extent the OWNER has agreed to comply with these measures. In the event that recommendations or regulations will not be followed, DEQ shall resolve any disputes regarding state highways.

2.6.2. In areas where the construction creates a hazard, traffic shall be controlled according to the applicable MDT regulations. Safety signs advising motorists of construction equipment shall be placed on major state highways, as recommended by MDT. The installation of proper road signing shall be the responsibility of the OWNER.

2.6.3. The managing agency shall be notified, as soon practicable, when it is necessary to close public roads to public travel for short periods to provide safety during construction.

2.6.4. Construction vehicles and equipment shall be operated at speeds safe for existing road and traffic conditions.

2.6.5. Traffic delays shall be restricted on primary access routes, as determined by MDT on state or federal highways or FS on its roads.

2.6.6. Access for fire and emergency vehicles shall be provided for at all times.

2.6.7. Public travel through and use of active construction areas shall be limited at the discretion of the managing agency.

2.7. ACCESS ROADS AND VEHICLE MOVEMENT

2.7.1. Construction of new roads shall be the minimum reasonably required to construct and maintain the facility in accordance with the Road Management Plan in Appendix D. National Forest System, State, county, and other existing roads shall be used for construction access wherever possible. The location of access roads and structures shall be established in consultation with affected LANDOWNERS and LANDOWNER concerns shall be accommodated where reasonably possible and not in contradiction to these specifications or other appropriate FS and DEQ conditions.

2.7.2. All new roads, both temporary and permanent, shall be constructed with the minimum possible clearing and soil disturbance to minimize erosion, as specified in Section 2.11 of these specifications.

2.7.3. Where practical, all roads shall be initially designed to accommodate one-way travel of the largest piece of equipment that will be required to use them; road width shall be no wider than necessary.

2.7.4. Roads shall be located as approved in the Road Management Plan (Appendix D). Travel outside the right-of-way to enable traffic to avoid cables and conductors during conductor stringing shall be kept to the minimum possible. Road crossings of the right-of-way shall be near support structures to the extent feasible.

2.7.5. Helicopter construction techniques shall be used as specified on Figure F-6 of the draft EIS. Helicopter stringing shall also be used on the line. Where overland travel routes are used, they shall not be graded or bladed unless necessary and shall be flagged or otherwise marked to

show their location and to prevent travel off the overland travel route. Where temporary roads are required, they shall be constructed on the most level land available.

2.7.6. In order to minimize soil disturbance and erosion potential, cutting and filling for access road construction shall be kept to a minimum to the extent practicable, in areas of up to 5 percent side slope. In areas of over 5 percent side slope, roads shall be constructed to prevent channeling of runoff.

2.7.7. The OWNER shall complete the measures necessary so the KNF could place all new roads constructed for the transmission line on NFSL into intermittent stored service. Such requirements are described in Appendix D. The OWNER shall restrict access to closed roads during construction. Closure devices shall be reinstalled following construction on existing closed roads. On private lands, the OWNER shall cooperate with the LANDOWNER to develop a similar approach to meet the LANDOWNER's land use requirements while minimizing environmental impacts.

2.7.8. Any damage to existing private roads, including rutting, resulting from project construction, operation, or decommissioning shall be repaired and restored to a condition as good or better than original as soon as possible. Repair and restoration of roads shall be accomplished during and following construction as necessary to reduce erosion.

2.7.9. Any necessary snow removal shall be done in a manner to preserve and protect roads, signs, and culverts, to ensure safe and efficient transportation, and to prevent excessive erosion damage to roads, streams, and adjacent land. All snow removal shall be done in compliance with INFS standards.

2.7.10. At least 30 days prior to construction of a new access road approach intersecting a state or federal highway, or of any structure encroaching upon a highway right-of-way, the OWNER shall submit to MDT a plan and profile map showing the location of the proposed construction. At least five days prior to construction, the OWNER shall provide the designated INSPECTORS written documentation of this consultation and actions to be taken by the OWNER as provided in 2.6.1.

2.8. EQUIPMENT OPERATION

2.8.1. During construction, unauthorized cross-country travel and the development of roads other than those approved shall be prohibited. The OWNER shall be liable for any damage, destruction, or disruption of private property and land caused by his construction personnel and equipment as a result of unauthorized cross-country travel and/or road development.

2.8.2. To prevent excessive soil damage in areas where a graded roadway has not been constructed, the limits and locations of access for construction equipment and vehicles shall be clearly marked or specified at each new site before any equipment is moved to the site. CONTRACTOR personnel shall be well versed in recognizing these markers and shall understand the restriction on equipment movement that is involved.

2.8.3. Dust control measures on all roads used for construction shall be implemented in accordance with DEQ's air quality permit and the KNF's Plan of Operations. Where requested by residents living within 500 feet of the line, the OWNER shall control dust created by transmission line construction activities. Oil or similar petroleum-derivatives shall not be used to control dust.

2.8.4. Work crew foremen shall be qualified and experienced in the type of work being accomplished by the crew they are supervising. Earthmoving equipment shall be operated only by qualified, experienced personnel. Correction of environmental damage resulting from operation of equipment by inexperienced personnel shall be the responsibility of the OWNER. Repair of damage to a condition reasonably satisfactory to the LANDOWNER, FS, or if necessary, DEQ, will be required.

2.8.5. Sock lines or pulling lines shall be strung using a helicopter to minimize disturbance of soils and vegetation.

2.8.6. Following construction in areas designated by the local weed control board, DEQ, or FS on NFSL as a noxious weed areas, the CONTRACTOR shall thoroughly clean all vehicles and equipment to remove weed parts and seeds immediately prior to leaving the area. Such areas are shown in Appendix K.

2.9. RIGHT-OF-WAY CLEARING AND SITE PREPARATION

2.9.1. The STATE INSPECTOR shall be notified at least 10 days prior to any vegetation clearing; the STATE INSPECTOR and KNF shall be notified at least 10 days prior to any vegetation clearing on NFSL. The STATE INSPECTOR shall be responsible for notifying the DNRC Forestry Division. All vegetation clearing shall be conducted in accordance with the Vegetation Removal and Disposition Plan (Appendix F).

2.9.2. Right-of-way clearing shall be kept to the minimum necessary to meet the requirements of the National Electrical Safety Code. Clearing shall produce a "feathered edge" right-of-way configuration, where only specified hazard trees and those that interfere with construction or conductor clearance are removed. Trees to be saved within the clearing back lines and danger trees located outside the clearing back lines shall be marked. Clearing back lines in SENSITIVE AREAS shall be indicated on plan and profile maps. All snags and old growth trees that do not endanger the line or maintenance equipment shall be preserved. In designated SENSITIVE AREAS, the INSPECTORS may approve clearing measures and boundaries that vary from the design plan prior to clearing.

2.9.3. During clearing of survey lines or the right-of-way, small trees and shrubs shall be preserved to the greatest extent possible in accordance with the Vegetation Removal and Disposition Plan and in compliance with the National Electrical Safety Code. Shrub removal shall be limited to crushing where necessary. Plants may be cut off at ground level, leaving roots undisturbed so that they may re-sprout.

2.9.4. In no case shall the cleared width be greater than that described in the Vegetation Removal and Disposition Plan and the National Electrical Safety Code, unless approved by the INSPECTORS on NFSL and the State INSPECTOR and LANDOWNER on private land.

2.9.5. Soil disturbance and earth moving shall be kept to a minimum.

2.9.6. The OWNER shall be held liable for any unauthorized cutting, injury or destruction to timber whether such timber is on or off the right-of-way.

2.9.7. Unless otherwise requested by the LANDOWNER or FS, felling shall be directional in order to minimize damage to remaining trees. Maximum stump height shall be no more than 12 inches on the uphill side or 1/3 the tree diameter, whichever is greater. Trees shall not be pushed or pulled over. Stumps shall not be removed unless they conflict with a structure, anchor, or roadway.

2.9.8. Crane landings shall be constructed on level ground unless extreme conditions (such as soft or marshy ground) make other construction necessary. In areas where more than one crane landing per structure site is built, the STATE INSPECTOR shall be notified at least 5 days prior to the beginning of construction at those sites.

2.9.9. No motorized travel on, scarification of, or displacement of talus slopes shall be allowed except where approved by the STATE INSPECTOR on all lands, the KNF INSPECTOR on NFSL, and LANDOWNER.

2.9.10. To avoid unnecessary ground disturbance, counterpoise should be placed or buried in disturbed areas whenever possible.

2.9.11. Slash resulting from project clearing that may be washed out by high water the following spring shall be removed and piled outside the floodplain before runoff. Any instream slash resulting from project clearing to be removed shall be removed within 24 hours. OWNER shall leave large woody material for small mammals and other wildlife species within the cleared area on NFSL.

2.9.12. Use of heavy equipment to clear and remove vegetation in riparian areas shall be minimized.

2.10. GROUNDING

2.10.1 Grounding of fences, buildings, and other structures on and adjacent to the right-of-way shall be done according to the specifications of the National Electrical Safety Code.

2.11. EROSION AND SEDIMENT CONTROL

2.11.1. Clearing and grubbing for roads and rights-of-way and excavations for stream crossings shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. At a minimum, erosion control measures described in the OWNER's Storm Water

Pollution Prevention Plan and INFS standards shall be implemented as appropriate following the review of the plan and profile map(s) required under Section 0.9 and 1.1.2.

2.11.2. Roads shall cross drainage bottoms at sharp or nearly right angles and level with the stream bed whenever possible. Temporary bridges, fords, culverts, or other structures to avoid stream bank damage shall be installed.

2.11.3. Under no circumstances shall stream bed materials be removed for use as backfill, embankments, road surfacing, or for other construction purposes.

2.11.4. No excavations shall be allowed on any river or perennial stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

2.11.5. Installation of culverts, bridges, or other structures at stream crossings shall be done as specified by the INSPECTORS following on-site inspections with DEQ, FS, FWP, and local conservation districts. Installation of culverts or other structures in a water of the United States shall be in accordance with the U.S. Army Corps of Engineers 404 and DEQ 318 permit conditions. All culverts shall be sized according to Revised Hydraulic Guide Kootenai National Forest (1990) and amendments. Where new culverts are installed, they shall be installed with the culvert inlet and outlet at natural stream grade or ground level. Water velocities or positioning of culverts shall not impair fish passage. Stream crossing structures need to be able to pass the 100 year flow event.

2.11.6. Following submittal of a plan and profile maps, but prior to construction of access roads, bridges, fill slopes, culverts, impoundments, or channel changes within the high-water mark of any perennial stream, lake, or pond, the OWNER shall discuss proposed activities with the STATE INSPECTOR, FWP, local conservation district, and KNF personnel. This site review shall determine the specific mitigation measures to minimize impacts appropriate to the conditions present. These measures shall be added to Appendix A by the STATE INSPECTOR and as appropriate by the KNF INSPECTOR.

2.11.7. No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to protect the stream from debris and from entry of nitrates or other contaminants into the stream. No blasting debris shall be placed into a water of the United States without a U.S. Army Corps of Engineers 404 and DEQ 318 permit.

2.11.8. The OWNER shall maintain roads on private lands while using them. All ruts made by machinery shall be filled or graded to prevent channeling. In addition, the OWNER must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include but are not limited to, installing or using cross-logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these. Erosion control shall be accomplished as described in the OWNER's General Stormwater Permit (or MPDES Permit) and the Storm Water Pollution Prevention Plan.

2.11.9. The OWNER shall prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep excavated materials and other extraneous materials out of watercourses. Any such materials entering watercourses shall be removed immediately.

2.11.10. The OWNER shall be responsible for the stability of all embankments created during construction. Embankments and backfills shall contain no stream sediments, frozen material, large roots, sod, or other materials that may reduce their stability.

2.11.11. No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

2.11.12. No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads.

2.11.13. Skidding with tractors shall not be permitted within 100 feet of streams containing flowing water except in places designated in advance, and in no event shall skid roads be located on these stream courses. Skid trails shall be located high enough out of draws, swales, and valley bottoms to permit diversion of runoff water to natural undisturbed forest ground cover.

2.11.14. Construction methods shall prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Secondary containment catchment basins capable of containing the maximum accidental spill shall be installed at areas where fuel, chemicals or oil are stored. Any accidental spills of such materials shall be cleaned up immediately.

2.11.15. To reduce the amount of sediment entering streams, vegetation clearing in Riparian Habitat Conservation Areas on NFSL and other riparian areas on private lands shall be conducted in accordance with the Vegetation Removal and Disposition Plan and the Storm Water Pollution Prevention Plan, to be submitted for approval by the DEQ and the FS.

2.11.16. Damage resulting from erosion or other causes from construction activities and disturbance areas shall be repaired after completion of grading and before revegetation is begun.

2.11.17. Stormwater discharge of water shall be dispersed in a manner to avoid erosion or sedimentation of streams as required in DEQ permits.

2.11.18. Riprap or other erosion control activities shall be planned based on possible downstream consequences of activity, and installed during the low flow season if possible. Timing restrictions are presented in Appendix I.

2.11.19. Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other wastewater processes shall not be discharged into surface waters without a valid discharge permit from DEQ.

2.12. ARCHAEOLOGICAL, HISTORICAL, AND PALEONTOLOGIC RESOURCES

2.12.1. All construction activities shall be conducted so as to prevent damage to significant archaeological, historical, or paleontological resources, in accordance with the requirements of 1.4.1 and Appendix E.

2.12.2. Any relics, artifacts, fossils or other items of historical, paleontological, or archaeological value shall be preserved in a manner agreeable to both the LANDOWNER and the SHPO. If any such items are discovered during construction, SHPO shall be notified immediately. If any such items are discovered on NFSL during construction, the FS Archaeologist shall also be notified immediately. Work which could disturb the materials or surrounding area must cease until the site can be properly evaluated by a qualified archaeologist (either employed by the OWNER and approved by the appropriate agency, managing agency, or representing SHPO) and recommendations made by that person based on the Historic Preservation Plan outlined in Appendix E. For sites eligible for listing in the National Registry of Historic Places, recommendations of SHPO must be followed by the OWNER.

2.12.3. The OWNER shall conform to treatments recommended for cultural resources by SHPO and the FS if on NFSL and on private land with concurrence by the LANDOWNER.

2.13. PREVENTION AND CONTROL OF FIRES

2.13.1. Burning, fire prevention, and fire control shall meet the requirements of the managing agency and/or the fire control agencies having jurisdiction. The STATE and KNF INSPECTORS shall be invited to attend all meetings with these agencies to discuss or prepare these plans. A copy of agreed upon plans shall be included in Appendix L

2.13.2. The OWNER shall direct the CONTRACTOR to comply with regulations of any county, town, state or governing municipality having jurisdiction regarding fire laws and regulations.

2.13.3. Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

2.13.4. The OWNER shall direct the CONTRACTOR to properly store and handle combustible material that could create objectionable smoke, odors, or fumes. The OWNER shall direct the CONTRACTOR not to burn refuse such as trash, rags, tires, plastics, or other debris, except as permitted by the county, town, state, or governing municipality having jurisdiction.

2.14. WASTE DISPOSAL

2.14.1. The OWNER shall direct the CONTRACTOR to use licensed solid waste disposal sites. Inert materials (Group III wastes) may be disposed of at licensed Class III landfill sites; mixed refuse (Group II wastes) must be disposed of at licensed Class II landfill sites.

2.14.2. Emptied pesticide containers or other chemical containers must be triple rinsed to render them acceptable for disposal in Class II landfills or for scrap recycling pursuant to ARM 17.54.201 for treatment or disposal. Pesticide residue and pesticide containers shall be disposed of in accordance with ARM 17.30.637.

2.14.3. All waste materials constituting a hazardous waste defined in ARM 16.44.303, and wastes containing any concentration of polychlorinated biphenyls must be transported to an approved designated hazardous waste management facility (as defined in ARM 17.53.201) for treatment or disposal.

2.14.4. All used oil shall be hauled away and recycled or disposed of in a licensed Class II landfill authorized to accept liquid wastes or in accordance with 2.14.2 and 2.14.3 above. There shall be no intentional release of oil or other toxic substances into streams or soil. In the event of an accidental spill into a waterway, the INSPECTORS shall be contacted immediately. Any spill of refined petroleum products greater than 25 gallons must be reported to the State at the Department of Military Affairs, Disaster and Emergency Services Division at 406-841-3911. All spills shall be cleaned up in accordance with the OWNER's Emergency Spill Response Plan.

2.14.5. Sewage shall not be discharged into streams or streambeds. The OWNER shall direct the CONTRACTOR to provide refuse containers and sanitary chemical toilets, convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local health laws and regulations. A septic tank pump licensed by the State shall service these facilities.

2.14.6. Slash from vegetation clearing along the transmission line shall be managed in accordance with the Vegetation Removal and Disposition Plan, Montana law regarding reduction of slash (76-13-407, MCA) and, on NFSL, KNF objectives regarding fuels reduction.

2.14.7 On NFSL, merchantable timber shall be transported to designated landings or staging areas, and branches and tops shall be removed and piled. The FS shall be responsible for disposing of the piles on NFSL and the OWNER shall be responsible for disposal of the piles on other lands. All merchantable timber shall be removed from the transmission line clearing area on NFSL unless authorized in writing by an authorized FS representative. Non-merchantable trees and coniferous forest debris shall be removed using a brush blade or excavator to minimize soil accumulation. Excess slash shall be removed or burned in all timber harvest areas and within ½ mile of any residence. The FS shall be responsible for disposing of the piles on FS land and the OWNER shall be responsible for disposal of the piles on other lands. Non-merchantable material left within the transmission line clearing area shall be lopped and scattered unless otherwise requested by the KNF.

2.14.8. On private land, management of merchantable and non-merchantable trees as well as slash shall be negotiated between LANDOWNER and OWNER.

2.14.9. Refuse burning shall require the prior approval of the LANDOWNER and a Montana Open Burning Permit must be obtained from the DEQ. Any burning of wastes shall comply with section 2.13 of these specifications.

3.2.10. Burning of vegetation shall be in accordance with the Vegetation Removal and Disposition Plan. Piling and windrowing of material for burning shall use methods that shall prevent significant amounts of soil from being included in the material to be burned and minimize destruction of ground cover. Piles shall be located so as to minimize danger to timber and damage to ground cover when burned.

2.15. SPECIAL MEASURES

2.15.1 Structures and conductors with a low reflectivity constant shall be used to reduce potential for visual contrast.

2.15.2 Crossings of rivers should be at approximately right angles. Strategic placement of structures should be done both as a means to screen views of the transmission line and right-of-way and to minimize the need for vegetative clearing.

2.15.3 To prevent avian collisions with the transmission lines, the visibility of conductors or shield wires shall be increased where necessary. This may include installation of marker balls, bird diverters, or other line visibility devices placed in varying configurations, depending on line design and location. Areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device, shall be identified through a study conducted by a qualified biologist and funded by the OWNER.

2.15.4 Based on the analysis contained in the EIS and findings made by the DEQ or the BOARD, general mitigations also may apply to construction and operation of the project. These measures are found in Appendix A.

3.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

3.1. CLEANUP

3.1.1. All litter resulting from construction is to be removed, to the satisfaction of the LANDOWNER on private lands and the FS on NFSL, from the right-of-way and along access roads leading to the right-of-way. Such litter shall be legally disposed of as soon as possible, but in no case later than 60 days following completion of wire clipping. If requested by the LANDOWNER and the FS on NFSL, the OWNER shall provide for removal of any additional construction-related debris discovered after this initial cleanup.

3.1.2. Insofar as practical, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, soil stockpiles, excess or waste materials,

or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical, in consultation with the LANDOWNER and the FS on NFSL.

3.2 RECLAMATION

3.2.1 Revegetation of the right-of-way, access roads, all special use area, or any other disturbance shall be consistent with the reclamation and revegetation standards and provisions contained in ARM 17.20.1902 and the approved Plan of Operations on NFSL. This plan and any conditions to the certificate approved by DEQ shall be attached as Appendix M.

3.2.2 Scarring or damage to any landscape feature listed in Appendix A shall be reclaimed as nearly as practical to its original condition. Bare areas created by construction activities shall be reseeded in compliance with Appendix M to prevent soil erosion.

3.2.3 After construction is complete, NFSL roads shall be reclaimed as described in Appendix D. Roads on private lands shall be managed in accordance with the agreement between LANDOWNER and OWNER.

3.2.4. Fill slopes associated with access roads adjacent to stream crossing shall be regraded at slopes less than the normal angle of repose for the soil type involved.

3.2.5. All drainage channels, where construction activities occurred, shall be restored to a gradient and width that shall prevent accelerated gully erosion (see Section 2.11.11).

3.2.6. Drive-through dips, open-top box culverts, waterbars, or cross drains shall be added to roads at the proper spacing and angle as necessary to prevent erosion. The suggested spacing of drive thru dips and relief culverts is discussed in the KNF Revised Hydraulic Guide (1990) and shall be used to establish the locations of these items.

3.2.7. Interrupted drainage systems shall be restored.

3.2.8. Sidecasting of waste materials may be allowed on slopes over 40 percent after approval by the LANDOWNER and FS, however, this will not be allowed within the buffer strip established for stream courses, in areas of high or extreme soil instability, or in other SENSITIVE AREAS identified in Appendix A. Surplus materials shall be hauled to sites approved by LANDOWNER and FS in such areas.

3.2.9. Seeding prescriptions to be used in revegetation, requirements for hydroseeding, fertilizing, and mulching, as jointly determined by representatives of the OWNER, DEQ, FS, and other involved state and federal agencies, are specified in Appendix M.

3.2.10. During the initial reclamation of construction disturbance in areas where topsoil has been stockpiled, the surface shall be graded to a stable configuration and the topsoil shall be replaced on the disturbed area. The STATE INSPECTOR may waive the requirement for topsoil replacement on private lands on a site-specific basis where additional disturbance at a site

increases erosion, sedimentation, or reclamation problems. Similarly, the KNF INSPECTOR may waive such requirements on NFSL.

3.2.11. Excavated material not suitable or required for backfill shall be evenly filled back onto the cleared area prior to spreading any stockpiled soil. Large rocks and boulders uncovered during excavation and not buried in the backfill shall be disposed of as approved by the STATE and KNF INSPECTORS and/or LANDOWNER.

3.2.12. Application rates and timing of seeds and fertilizer, and purity and germination rates of seed mixtures, shall be as determined in consultation with DEQ and FS. Reseeding shall be done at the first appropriate opportunity after construction ends.

3.2.13. Where appropriate, hydro seeding, drilling, or other appropriate methods shall be used to aid revegetation. Mulching with straw, wood chips, or other means shall be used where necessary. Areas requiring such treatment are listed in Appendix M.

3.3. MONITORING CONSTRUCTION AND RECLAMATION ACTIVITIES

3.3.1. Upon notice by the OWNER, the INSPECTORS shall schedule initial post-construction field inspections following clean up and road closure. Follow-up visits shall be scheduled as required to monitor the effectiveness of erosion controls, reseeding measures, and the Reclamation and Revegetation Plan (Appendix M). The STATE INSPECTOR shall contact the LANDOWNER for post-construction access and to determine LANDOWNER satisfaction with the OWNER'S reclamation measures.

3.3.2. The STATE INSPECTOR shall document observations on all lands for inclusion in monitoring reports regarding bond release required by DEQ. Such observations shall be coordinated with the KNF INSPECTOR on NFSL and the OWNER.

3.3.3. Release of the Transmission Line Construction and Reclamation Bond shall be based on completing the activities specified in the Reclamation and Revegetation Plan (Appendix M). Failure of the OWNER to complete the activities on disturbed areas in accordance with Appendix M and successfully revegetate disturbed areas shall be cause for forfeiture for the BOND or penalties described in Section 0.3. Failure of the OWNER to adequately reclaim all disturbed areas in accordance with section 3.2 and Appendix M of these specifications shall be cause for forfeiture of the BOND or penalties described in Section 0.9. Reclamation shall be in accordance with the standards established in ARM 17.20.1902 and in forested areas the right of way and unneeded roads shall be stocked naturally or planted with trees so that upon maturity, the canopy cover approximates that of adjacent undisturbed areas. Noxious weeds shall be controlled on disturbed areas.

4.0. OPERATION AND MAINTENANCE

4.1. RIGHT-OF-WAY MANAGEMENT

4.1.1. Maintenance of the right-of-way shall be as specified in the Weed Control Plan (Appendix K) and other monitoring and mitigation plans described in the KNF's Plan of Operations. This plan shall provide for the protection of SENSITIVE AREAS identified prior to and during construction. OWNER and CONTRACTOR activities off the right-of–way such as along access roads shall be consistent with best management practices and environmental protection measures contained in these specifications.

4.1.2. Vegetation that has been saved through the construction process and which does not pose a hazard or potential hazard to the transmission line, particularly that of value to fish and wildlife as specified in Appendix A, shall be allowed to grow on the right-of-way. Vegetation management shall be in accordance with the Vegetation Removal and Disposition Plan (Appendix F).

4.1.3. Vegetative cover along the transmission line and roads shall be maintained in cooperation with the LANDOWNER on private lands and the FS on NFSL.

4.1.4. Grass cover, water bars, cross drains, the proper slope, and other agreed to measures shall be maintained on permanent access roads on private lands and service roads in order to prevent soil erosion.

4.2. MAINTENANCE INSPECTIONS

4.2.1. The OWNER shall have responsibility to correct soil erosion or revegetation problems on the right-of-way or access roads as they become known. Maintenance of roads on NFSL shall be in accordance with the Road Management Plan. Appropriate corrective action shall be taken where necessary. The OWNER, through agreement with the LANDOWNER or FS, may provide a mechanism to identify and correct such problems.

4.2.2. Operation and maintenance inspections using ground vehicles shall be timed so that routine maintenance shall be done when access roads are firm, dry, or frozen, wherever possible. New roads, and existing barriered or impassable roads used for transmission line construction on NFSL shall not be used for routine maintenance; use of such roads shall be for emergency maintenance only. Maintenance vegetative clearing shall be done according to criteria described in Appendix F.

4.3. CORRECTION OF LANDOWNER PROBLEMS

4.3.1. When the facility causes interference with radio, TV, or other stationary communication systems, the OWNER shall correct the interference with mechanical corrections to facility hardware, or antennas, or shall install remote antennas or repeater stations, or shall use other reasonable means to correct the problem.

4.3.2. The OWNER shall respond to complaints of interference by investigating complaints to determine the origin of the interference. If the interference is not caused by the facility, the OWNER shall so inform the person bringing the complaint. The OWNER shall provide the

STATE INSPECTOR with documentation of the evidence regarding the source of the interference if the person brings the complaint to the STATE INSPECTOR or DEQ.

4.4. HERBICIDES AND WEED CONTROL

4.4.1. To minimize spreading weeds during construction, a joint weed inspection of the transmission line corridor and/or construction areas may be completed prior to construction areas. The joint inspection is intended to identify areas with existing high weed concentration. This joint review may include the OWNER, affected weed control boards, FS and LANDOWNERS.

4.4.2. Weed control, including any application of herbicides in the right-of-way, shall be done by applicators licensed in Montana and in accordance with recommendations of the Montana Department of Agriculture, FS on NFSL, and in accordance with the Weed Control Plan in Appendix K.

4.4.3. Herbicides shall not be used in certain areas identified by DEQ, FS, and FWP, as listed in Appendix K.

4.4.4. Proper herbicide application methods shall be used to keep drift and nontarget damage to a minimum.

4.4.5. The OWNER shall notify the STATE and KNF INSPECTORS (if involving NFSL) in writing 30 days prior to any broadcast or aerial spraying of herbicides. The notice shall provide details as to the time, place, and justification for such spraying. DEQ, FWP, the Montana Department of Agriculture, and FS, if involving NFSL, shall have the opportunity to inspect the portion of the right-of-way or access roads schedule for such treatment before, during, and after spraying.

4.5. CONTINUED MONITORING

4.5.1. The KNF and DEQ may continue to monitor operation and maintenance activities for the life of the transmission line in order to ensure compliance with the KNF's Plan of Operations and the Certificate of Compliance.

5.0. ABANDONMENT, DECOMMISSIONING AND RECLAMATION FOLLOWING DECOMMISSIONING

When the transmission line is no longer used or useful, structures, conductors, and ground wires shall be removed, roads recontoured and disturbed areas reclaimed using methods outlined in Appendix N.

APPENDICES

Appendix A: Sensitive Areas for the Montanore Project.

The following sensitive areas have been identified on Figure D-1 of the draft EIS where special measures will be taken to reduce impacts during construction and reclamation activities:

- Wetlands
- Riparian corridors
- Bull trout critical habitat
- Old growth habitat
- Core grizzly bear habitat
- Bald eagle primary use areas
- Areas with high risk of bird collisions
- Big game winter range
- Visually sensitive and high visibility areas
- Cultural resources (not shown on Figure D-1)
- Additional areas for monitoring may be identified following the preconstruction monitoring trip by the INSPECTORS or preconstruction surveys by the OWNER (see Appendix I)

Area where helicopters will be used to construct the line are identified in Figure F-6 of the draft EIS. Helicopter stringing of the line will be required to minimize construction disturbance during the stringing phase.

Once the preferred alignment has been selected by the FS and the DEQ during the EIS process, specific areas will be identified and mitigation incorporated into the final design to address sensitive areas of the transmission line.

Appendix B: Performance Bond Specifications

The Transmission Line Construction and Reclamation Bond and Joint Decommissioning Bond shall be used to ensure compliance with these specifications. The amount of the Construction and Reclamation Bond will be determined by the DEQ and FS within 45 days after the information required is Section 1.1 – 1.3 has been submitted. The Joint Decommissioning Bond will also be determined by the DEQ and FS with in 45 days the information required in Section 1.1 – 1.3 has been submitted. These bonds must be submitted prior to the start of construction. The amount of the bonds will be reviewed and updated every 5 years by DEQ and FS.

Appendix C: Name and Address of Inspectors and Owner's Liaison

STATE INSPECTOR
Environmental Science Specialist
Montana Department of Environmental Quality
P.O. Box 200901, 1520 East Sixth Avenue
Helena, Montana 59620-0901
(406) 444-____

OWNER'S LIAISON
Environmental Specialist
Montanore Minerals Corp.
34524 U.S. Highway 2 West
Libby Montana 59923
(406) 293_____

KNF INSPECTOR
Kootenai National Forest
1101 U.S. Highway 2 West
Libby Montana 59923
(406) 293-_____

Appendix D: Road Management Plan

OWNER shall develop for the lead agencies' review and approval, and implement a final Road Management Plan that describes for all new and reconstructed roads used for the transmission line the following:

- Criteria that govern road operation, maintenance, and management
- Requirements for pre-, during-, and post-storm inspections and maintenance
- Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives
- Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control
- Mitigation plans for road failures

OWNER shall be responsible for implementing one or more of the following measures on newly constructed roads and reconstructed roads on NFSL so they cause little resource risk if maintenance is not performed on them during the operation period and prior to their future need:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities
- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high-risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function

- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

The OWNER shall decommission new transmission line roads on NFSL after removal of transmission line. OWNER shall be responsible for implementing one or more of the following measures on new roads on NFSL to minimize the effects on other resources:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary
- Stabilizing fill slopes
- Fully obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism
- Removing unstable fills

On private lands the same measures shall be applied unless the certificate holder contracts with the landowner for revegetation or reclamation as allowed under ARM 17.20.1902.

Appendix E: Cultural Resources Protection and Mitigation Plan

The final Cultural Resources Protection and Mitigation Plan will be incorporated into these specifications.

Appendix F: Vegetation Removal and Disposition Plan

As part of final design, MMC shall prepare a Vegetation Removal and Disposition Plan for lead agency review and approval. One of the plan's goals will be to minimize vegetation clearing. The plan will identify areas where clearing will be avoided, such as deep valleys with high line clearance, and measures that will be implemented to minimize clearing. For example, the growth factor used to assess which trees wo;; require clearing could be reduced in sensitive areas, such as RHCAs, from 15 years to 5 to 8 years. The plan also will evaluate the potential uses of vegetation removed from disturbed areas, and describe disposition and storage plans during life of the line. The Vegetation Removal and Disposition Plan will be part of and incorporate details of the final design for the transmission line.

Appendix G: Variations in Right-of-Way Width

DEQ does not recommend specific widths for construction easements. In accordance with the specifications, construction activities shall be contained in the minimum area necessary for safe and prudent construction and approved by the FS on NFSL.

DEQ does not recommend specific variations in right-of-way widths beyond those required to meet the National Electric Safety Code for electric transmission line operations and those necessary to meet standards established in ARM 17.20.1607 (2).

Appendix H: Monitoring Plan

The STATE INSPECTOR is responsible for implementing this monitoring plan required by 75-20-303(b) and (c), MCA, and for reporting whether terms of the Certificate and Environmental Specifications (including but not limited to adequacy of erosion controls, successful seed germination, and areas where weed control is necessary) are being met, along with any conditions in the MPDES General Permit for Storm Water Discharges Associated with Construction Activity and Authorization associated with the transmission line. Additional mitigating measures may be identified by the STATE INSPECTOR or by the KNF INSPECTOR on NFSL in order to minimize environmental damage due to unique circumstances that arise during construction.

In addition to participating in preconstruction conferences, the INSPECTORS shall conduct on-site inspections during the period of construction. At a minimum the INSPECTORS will be present at the start of construction and during the initiation of construction in sensitive areas. Subsequently INSPECTORS shall strive to conduct on-site reviews of construction activities on at least a weekly schedule. More frequent monitoring may be necessary.

INSPECTORS shall record the dates of inspection, areas inspected, and instances where construction activities are not in conformance with Environmental Specifications or terms and conditions of the Certificate of Compliance for the project. Inspection reports shall be submitted in a timely manner to the OWNER's Liaison who will see that corrections are made or that such measures are implemented in a timely manner.

When violations of the Certificate are identified, the STATE INSPECTOR shall report the violation in writing to the OWNER, who shall immediately take corrective action. If violations continue, civil penalties described in 75-20-408, MCA may be imposed. In the event that the KNF INSPECTOR shows reasonable cause that compliance with the Plan of Operations is not being achieved, FS will implement measures described in 36 CFR 228.7(b).

Upon the completion of construction in an area, the INSPECTORS will determine that Environmental Specifications have been followed, and that activities described in Appendix M have been completed and vegetation is progressing in a satisfactory manner.

In the event the DEQ or FS finds that the OWNER is not correcting damage created during construction in a satisfactory manner or that initial revegetation is not progressing satisfactorily, DEQ may determine the amount and disposition of all or a portion of the reclamation bond to correct any damage that has not been corrected by the certificate holder.

Appendix I: Areas Where Construction Timing Restrictions Apply

Restrictions in the timing of tree removal are required on NFSL between April 15 and July 15 around nesting sites of the flammulated owl, black-backed woodpecker, or northern goshawk to assure compliance with the Migratory Bird Treaty Act and FS requirements. The OWNER will be required to complete surveys of the alignment to identify where timing restriction may be required. If surveys conducted one nesting season prior to construction activities does not find nesting of these species, such restrictions shall be rescinded. If surveys located nesting of these species, tree removal restrictions in an avoidance area appropriate for each species shall be in place during the nesting period until the young are fledged.

Restrictions in the timing of tree removal and other transmission line construction activities are required on all lands between February 1 and August 15 around bald eagle breeding sites to assure compliance with the Montana Bald Eagle Management Plan, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act and FS requirements. Surveys for the bald eagle shall be completed on appropriate habitat.

If an active nest was found, guidelines from the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994) will be followed to provide management guidance for the immediate nest site area (Zone 1), the primary use area (Zone 2), and the home range area (Zone 3). This includes delineating a ¼-mile buffer zone for the nest site area, along with a ½-mile buffer zone for the primary use area. High intensity activities, such as heavy equipment use, are not be permitted during the nesting season (February 1 to August 15) within these two zones. The Montana Bald Eagle Working Group recommendations apply during the 5-Year period following delisting of the bald eagle from the list of threatened and endangered species. If the Montana Bald Eagle Working Group recommendations lapse before the line is constructed, then the timing restrictions will revert to the National Bald Eagle Management Guidelines made by the US Fish and Wildlife Service in May 2007.

Restrictions in the timing of transmission line construction activities in elk, white-tailed deer, or moose winter range are required between December 1 and April 30. These timing restrictions may be waived in mild winters if it can be demonstrated that snow conditions are not limiting the ability of these species to move freely throughout their range. The OWNER must receive a written waiver of these timing restrictions from the KNF, DEQ, and FWP, before conducting construction activities on elk, white-tailed deer, or moose winter range between December 1 and April 30. Timing restrictions will not apply to substation construction.

Culvert or bridge installation is prohibited in areas of important fish spawning beds identified in Appendix A and during specified fish spawning seasons on less sensitive streams or

rivers. Riprap or other erosion control activities on NFSL affecting bull trout spawning habitat can only occur during May 15 and September 1.

Other timing restrictions as negotiated by LANDOWNERS in individual easement agreements shall be incorporated into these specifications.

Appendix J: Aeronautical Hazard Markings

DEQ does not recommend aeronautical hazard markings at this time. If a potential hazard is identified during final design, DEQ will consult with the Federal Aviation Administration and Montana Aeronautics Division of MDT to determine appropriate action or aeronautical safety marking.

Appendix K: Weed Control Plan

The final Weed Control Plan will be incorporated into these specifications.

Appendix L: Fire Prevention Plan

The final Fire Prevention Plan will be incorporated into these specifications.

Appendix M: Reclamation and Revegetation Plan

An interim and final Reclamation and Revegetation Plan will be developed and submitted to DEQ and FS for approval. This plan must, at a minimum, specify seeding mixtures and rates. It must satisfy LANDOWNER wishes, to the extent reasonable, requirements of the MPDES General Permit for Storm Water Discharges Associated with Construction Activity, and ARM 17.20.1902(10).

Because the reclamation of construction activities associated with the transmission line is considered interim and final reclamation will be required at mine closure, the primary objective of the interim reclamation plan is to provide long-term stability and control weed infestation during the operational phase of the project. The standards for interim reclamation used to determine construction bond release or to determine that expenditure of the reclamation bond is necessary to meet the requirements of the certificate for transmission lines will follow these primary objectives. MMC shall complete the following activities prior to release of the TRANSMISSION LINE CONSTRUCTION BOND:

- Implementation of the Weed Control Plan (Appendix K)
- Completion of all monitoring and mitigation described in the Cultural Resources Protection and Mitigation Plan (Appendix E)

- Completion of all interim reclamation activities described in the Reclamation and Revegetation Plan (Appendix M)
- Completion of all activities associated with roads used for transmission line construction described in the Road Management Plan (Appendix D)
- Completion of all activities associated with vegetation removal and disposal for transmission line construction described in the Vegetation Removal and Disposition Plan (Appendix F)
- Revegetation is proceeding satisfactorily.

Appendix N: Abandoning and Decommissioning Plan

Prior to the start of construction, the OWNER shall submit to the lead agencies for their approval an abandonment and decommissioning plan. Based on this plan, the agencies will then calculate the amount of the final reclamation bond.

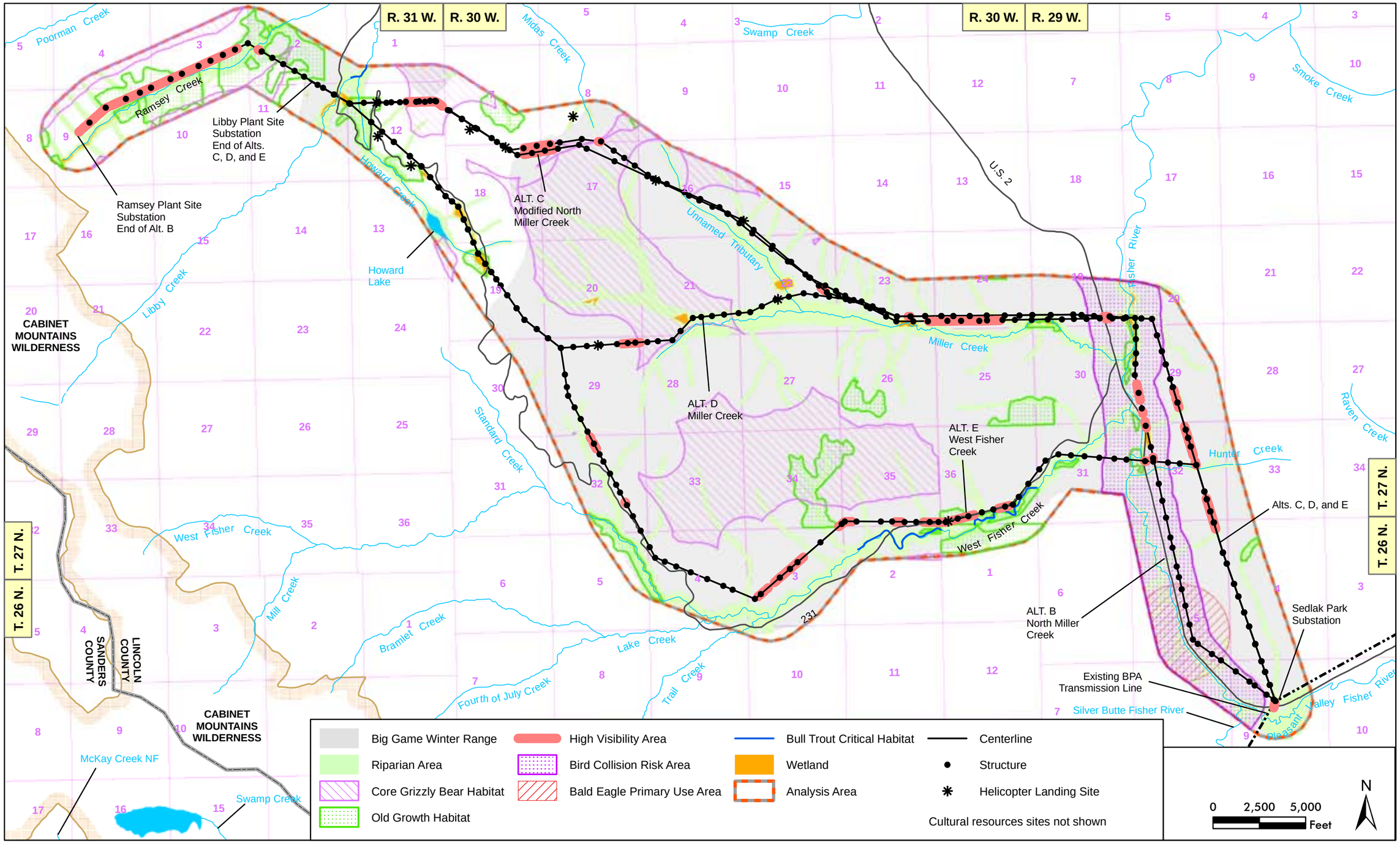


Figure D-1. Sensitive Areas Along Transmission Line Corridors

Appendix E—Past and Current Actions Catalog for the Montanore Project

Table E-1. Past and Current Actions Catalog for the Montanore Project (Alphabetical by Activity)

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Firewood Gathering														
Permits	1985		1312 permits											
Permits	1986		1550											
Permits	1987		1369											
Permits	1988		1122											
Permits	1989		1465											
Permits	1990		1405											
Permits	1991		1842											
Permits	1992		1687											
Permits	1993		1794											
Permits	1994		1805											
Permits	1995		1873											
Permits	1996		1942											
Permits	1997		1880											
Permits	1998		1543											
Permits	1999		1544											
Permits	2000		1762											
Permits	2001		1851											
Permits	2002		1775											
Permits	2003		1475											
Permits	2004		1837											
Permits	2005		1634											
Permits	2006		1765											
Because Fuelwood (Firewood) Permits purchased on the Kootenai National Forest may be used anywhere on the Forest, as well as anywhere within the boundaries of Region 1, statistical information regarding gathering locations is impractical to determine.														
Grazing Allotments														
Swede Mountain	1956-1971	USFS	1500 Acres				X							
McMillan	1956-1971	USFS	200 Acres	X										
McMillan	1956-1971	PVT	300 Acres	X										
Granite-Cherry	1956-1986	USFS	4000 Acres				X							
Granite-Cherry	1956-1986	USFS	2000 Acres	X										
Libby Creek	1956-1989	USFS	3900 Acres	X										
Libby Creek	1956-1989	PVT	500 Acres	X										
Libby Creek	1956-1989	State of MT	150 Acres	X										
Barren	1958-1990	USFS	1500 Acres			X								
West Fisher	1956-1971	USFS	600 Acres			X								
West Fisher	1956-1971	St. Regis	300 Acres			X								
Acres within Subunits are approximate.														

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Mineral Activities														
Gravel pit D5-30/ **active**/Miller Creek Pit	1994–present minimum	NFS lands	0.5 acre			X								
Rock quarry D5-35/ **active**/Miller Creek quarry	1994–present minimum	NFS lands	0.5 acre			X								
Gravel pit D5-14/ **active**/West Fisher River pit	1994–present minimum	NFS lands	0.5 acre			X				X				
Rock quarry D6-49/ **active**/Silver Butte Fisher quarry	1994–present minimum	NFS lands	0.1 acre			X								
Gravel pit D6-50/ active/Silver Butte Fisher pit	1994–present minimum	NFS lands	0.1 acre			X								
Gloria (Little Annie), West Fisher Creek	1930s 2001 last POO/adit closures completed 2007	NFS lands	40 acres active claim/surface disturbance less than 5 acres/mine road 1.5 miles			X				X				
Blacktail lode (aka Jumbo, Tip Top) claim – explore/ secure adits, Bramlett Creek	1909–1939 active inderground mine **Active POO 1993 – present**/minor activities/adit closures planned 2008	NFS lands	40 acres claimed/ surface disturbance less than 5 acres/road to mine approx 1 mile			X				X				
Viking lode Inactive mine, Silver Butte Creek/aka Gold Hill	1934–1940s inactive mine/mill/tram – active claim held, possible adit closures 2008/POO 1993–1995	NFS lands	20 acres active claim/surface disturbance mine road (approx 2 miles), trails, millsite, collapsed stopes, 5-8 acres			X								
A-Far Placer Silver Butte Creek (near Viking) – placer exploration/suction dredge POO	Proposed instream Suction dredge/placer exploration Pits/ **2007/08 analysis, possible 2008 implement**	NFS lands	Less than 2 acres surface disturbance on one placer claim			S								
Gold Hill – ***see Viking***														
American Kootenai Mine, W. Fisher (Bakie)	1890s–1906 active claims adjacent to private/one portal on claim – closure 2008/POO 1998	NFS lands	Less than 5 acres disturbance/mine road 1/2 mile			X				X				
American Kootenai claim group, West Fisher Creek	1890s–1906 patented group includes remnant of mill adj. to upper West Fisher Creek	PVT	162-acre parcel			X				X				
Mother Lode prospect (area of Gloria or Wayup) headwaters of West Fisher Creek	1915	NFS Lands	One adit 160 feet long			X				X				

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Wayup lode claim/inactive/ motorized access in litigation (C. Harpole), W. Fisher	1902–1910/1937–1949 underground mine/several open portals	PVT	26 parcel/use of road behind gate approx 2 miles			X				X				
Branagan lode claim/inactive	1901–1905/1940–1950 mill/ underground workings	PVT	113-acre parcel			X				X				
Irish Boy (Rambler) lode claim/inactive/currently analyzing motorized access request	1930s mine/ **analyzing access 2008**	PVT	30-acre parcel/ minor surface disturbances overgrown			X				X				
Fourth of July lode claim/inactive/access analyzed 1990s/in litigation (H. Skranak), Bramlett Creek	1960s motorized access in litigation late 1990s through 2008	PVT	29-acre parcel			X				X				
King Mine lode claim/inactive	Early 1900s–1950 – site of mill and underground workings	PVT	200-acre parcel			X								
Golden West (New Mine) lode claim/abandoned mine, West Fisher Creek	1940s – shallow adits/tram/closures planned for 2008	NFS lands	40 acres(?) claimed/less than 5 acres surface disturbance			X				X				
Union	Pre-1955 – millsite between Branlet and Mill Creek (tribs of West Fisher Creek)	PVT	Unknown			X				X				
Hannagan (Libby Prospect)	Pre-1948; aka Libby. West of Jumbo; caved adits; West Fisher Creek (part of American Kootenai private parcel)	PVT	Unknown			X				X				
Libby prospect – ***see Hannagan***	Hannagan	PVT	Unknown			X								
Mustang Mine ,Standard Creek	1930s–2003 intermittent Last POO 2003/reclaimed 2003	NFS lands	200 acres claimed/ surface disturbances reclaimed, portal closed			X				X				
Williams, Standard Creek	Pre-1948 – adits/cuts between Great Northern and Twin Peaks	NFS lands	Claim status – closed/minor surface disturbances			X				X				
Midas Mine, Standard Creek	1905–1948 extensive underground workings and mill/Standard Creek drainage	PVT	60-acre parcel			X				X				
Midas Mine lode claim inactive, Standard Creek	POO – 1989–1990 on 3 adits near W. edge of private land– AC Lewis caved portals	NFS lands	520 acres claimed/ less than 5 acres surface disturbance			X				X				

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Montezuma prospect (aka Silver Tip) /inactive – West Fisher Creek	1950s – shallow adits, pits, trenches, inactive (2 miles southeast of Midas mine) east side of West Fisher Creek. POO 1976–1992 (G.Shaw) Reclaimed 1993	NFS lands	20 acres (?) inactive claims/ surface disturbances (cabin site, prospects) reclaimed			X				X				
Silvertip-Lead prospect(part of Snowshoe group) between Big Cherry and Snowshoe creeks, above Cherry Creek Trail	Pre-1926	NFS lands	Pits, short adits/ less than 5 acres surface disturbance	X										
Miller Placer prospect/inactive – West Fisher Creek	1930s – one inaccessible shaft along West Fisher Creek, 2 miles S. of Teeters Peak	NFS lands	40 acres (?) claimed/minor surface disturbances			X				X				
Waylett Placer	1919 – lower Lyons Creek, trib. of Vermillion Creek east of Trout Creek, MT	NFS lands	Unknown											
Waylett group (aka Moose Hill, Royal) inactive-prospecting and reclamation aka Seclusion (AC Lewis) Miller Creek	1905–1960 prospect 1/2 mile SE of Midas Mine, Miller Creek near Teeters Peak/tungsten-qtz veins 1977 active; 1999 reclaimed POO – 1989–1998 (A.C. Lewis)	NFS lands	20 acres (?) inactive claims/ caved portals/ surface disturbances reclaimed			X				X				
Waylett North prospects	Pre-1948 – prospect east of Midas Mine	NFS lands	Claim status – closed/surface disturbances unknown			X				X				
Seclusion – ***see Waylett***						X								
Standard Lake area active lode claims	No POO/No activity	NFS lands	100 acres claimed/ no surface disturbances			X				X				
Sunrise prospect, near Silver Butte Pass (Rankin claims)	No POO	NFS lands	Unknown			X								
Silver Butte (NFS lands portion of King Mine)	No POO	NFS lands	40 acres closed claims/caved portals			X								
Snowfall Prospect – near Silver Butte Pass	No POO	NFS lands	1950s – 1.5 miles SE of King mine; 2 or more caved adits,disturbance unknown			X								
Illinois Montana group – ***see Bear Lakes***		NFS lands				X								

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Bear Lakes	**2005 EA – trail construction (implement date unknown)**	PVT	85-acre parcel/site of private cabin			X				X				
Bear Lakes mining claims adjacent to private land – no activity (aka Illinois Montana)	No POO	NFS lands	20 acres claimed/ unknown surface disturbances			X				X				
Silver Tip – ***see Montezuma***		NFS lands												
Gravel pit D5 – 22/ reclamation/ Leigh Creek pit	Inactive since early/mid-1980s	NFS lands	0.25 acre	X										
Gravel pit D5 – 26/ reclamation/Libby Creek Pit	Active prior to 1994	NFS lands	0.3 acre	X										
Rock Quarry/D5 – 31/status pending/Crazyman Quarry	Active prior to 1994	NFS lands	0.25 acre	X					X					
Gravel Pit D5 – 39/ **active**/Little Cherry Pit	Active since between 1994–1999	NFS lands	1 acre?	X					X					
Gravel Pit D5 –13/ **active**/Poorman Creek Pit	Active prior to 1994	NFS lands	2 acres	X					X					
Seattle (leased to St. Paul Lead Co., Big Cherry Creek/ prospect	1958–1964	NFS lands	Cuts, pits, caved adits	X										
Snowshoe Mine – inactive mine	1890s–1964 underground mine and surface facilities	PVT	4 lode claims – approx 80 acres/ appprox 25 acres surface disturbances being reclaimed	X										
Snowshoe Mine **CERCLA** clean-up site	**2007–2009 tailings removal, adit closures, stream reconstruction**	PVT	25 acres approx 180,000 cy tailings	X										
Snowshoe Mine Tailings along Snowshoe Creek/ **CERCLA clean-up site**	**2007–2009 tailings removal**	NFS lands	Approx 17,000 cy tailings/approx 2 acres	X										
Snowshoe CERCLA tailings "mixed tailings" **repository site**	Timber Cleared 2006/ **construction 2007/ place tailings 2008, complete reveg 2009**	NFS lands	17 acres distrubed	X										
Zollars aka St. Paul (Oro Mining, Silver Star Mine) claims contiguous with Snowshoe group – ***see Raven (Shaw)***				X										
Texas Ranger group – ***see Snowshoe Mine***				X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Alpine Claim/Montana Silver-Lead/Big Sky Mining – Leigh Creek (near trailhead)	1897 located; 1915–1950s active; adits on steep slope/1994 proposal, no POO	NFS lands	Sloughed, overgrown, unknown	X										
Big Sky – ***see Alpine/ Montana Silver-Lead***				X										
Big Cherry Millsite	1950s	NFS lands	Approx 10 acres – mill and tailings ponds	X										
Big Cherry Millsite CERCLA tailings clean-up and repository construction	June–Oct. 2007 complete	NFS lands	Approx 15–20 acres millsite and repository and 5 acres of tailings along Big Cherry Creek	X										
Halfmoon – prospect on Poorman Creek side of Cable Mountain	1960s	NFS lands	Short tunnel, pits/ minor surface disturbance	X					X					
Cableway group – prospect	Unknown	NFS lands	Overgrown, unknown	X					X					
Statesman prospect – north side of Poorman Creek	Unknown	NFS lands	Shallow cuts; unknown	X					X					
John Bill – Uncle Sam inactive	Near Cable/Bear confluence	NFS lands	Collapsed adit, overgrown, minor surface disturbance	X					X					
Silver Cable Prospect/Mill (no production) Cable Creek	1930s	PVT	160 acre approx parcel size/one shallow open adit/use of approx 3 miles of road behind gate	X					X					
Silver Cable area unpatented claims (Wilbe claims Johnson/Prokop) Cable Creek	**1993–present POO for access only** (claim assessment work only) using road behind gate	NFS lands	One shallow adit/ less than 5 acres surface disturbance/use of approx 2 miles road use behind gate	X					X					
Montanore (formerly Johnstone Placer patented claim) adit Libby Creek	**Active 1989–1995 and 2006–present/ EA for road use 2008**	PVT	Portal and surface facilities on approx 20 acres (89 acres total claimed in area)	X					X					

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Betty Mae prospect upper Libby Creek	Pre-1948 – shallow lode prospects, upper Libby Creek	NFS lands	Caved adits/minor surface disturbance	X						X				
Diamond John prospect, north side of upper Libby Creek	Pre-1948 adit	NFS lands	1 adit – 60 feet long	X					X					
Lost Grouse (aka Skranak, Bolyard Placer, or Vaughn and Greenwell) Libby Creek	Mining – intermittent 1890s–1995/ POO 1992,95,96; Lost Grouse reclamation planned 2008	NFS lands	Claim approx 20 acres/less than 5 acres surface disturbance, drillhole/mine road 1/2 mile	X					X					
AUMCO (Peterson) instream suction dredge in Libby Creek	**POO – 1979–present**	NFS lands	3 placer claims/ instream only; use of 6199 Rd behind gate approx 2 miles	X										
ALPINE PLACER instream suction dredge in Libby Creek/dry placer exploration (Logan Pit) (B. Ericksmoen)	**Suction dredge POO 1990–present /Logan Pit – 1914–1930s historic mining with POO 1982–present**	NFS lands	2 placer claims/ surface disturbance Logan Pit less than 5 acres/use of 6199 Rd behind gate approx 2.5 miles	X										
BACK ACRES (GPAA/ Taylor) instream suction dredge (formerly Ford Wilson placer)	**Active POO 3 years 2004–present/prior activity pits near bank POO 1993-2001**	NFS lands	1 placer claim/pits less than 5 acres disturbance	X										
CRAZYMAN instream suction dredge (inactive) aka Getner Placer	POO 1993–2005	NFS lands	2 active placer claims/instream, less than 1 acre on bank-access	X										
Getner Placer – ***see Crazyman***				X										
NWMGPA – Ace Placer Exploration	**Mid-1990s–present POO**	NFS lands	Less than 5 acres disturbance (pits), road approx 1/2 mile	X					X					
NWMGPA – LJ claims instream suction dredge	**Mid-1990s–present POO**	NFS lands	7 claims/instream only	X					X					
NWMGPA – Bent/99rs claims trenching; Big Cherry Creek	**POO 2005–2006 pits/reclaimed**	NFS lands	Reclaimed	X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
NWMGPA – Bent/99rs Claims – instream suction dredge Cherry Creek (includes Howard Placer active prior to 1955 (1929–1932)	1929–1932, 1955 – area active/**POO 1993–present**	NFS lands	2 claims/instream only	X										
Harry Howard Placer – ***see NWMGPA Bent/99rs***				X										
LUCKY STRIKE instream suction dredge (previously L-Oro claims)	**1992–present POO**	NFS lands	Approx 500 feet of stream within 1 placer claim, instream only	X										
Nugget Placer (Beckstrom)	**1929–1932 hydraulic mining/POO for access on 6199 Rd behind gate 1981–2004**	NFS lands	Instream panning/access on approx 2.5 miles road behind gate	X										
Zahav 1 – instream suction dredge proposal (formerly Viona) at Bear/Libby Creek confluence/historic mining area, adjacent to Nugget	**2007 proposed POO received; 2008 analysis for suction dredging and access; implement 2008 or 2009/previous POO 1999–2006**	NFS lands	1 placer claim, instream only/use of road behind gate 6199 Rd approx 2 miles	X										
Libby Creek Ventures (Bakie) Libby Creek	**POO exploration drilling Jan. 2006–Oct. 2008**	NFS lands	Proposed disturbance along Libby Creek Road less than 1/2 mile/no activity under POO as of Jan. 2008	X					X					
MYTEE FINE Placer – instream suction-dredge	New proposal in 2006 – **analysis completed in 2007 POO signed 2007 possible June 2008 implement**	NFS lands	Approx 500 feet of stream within 1 placer claim	X					X					
MYTEE FINE Placer – exploration pits and temp road	**POO Sept. 2007–Oct. 2009**	NFS lands	Less than 5 acres to disturb includes temp road	X					X					
GOOD MEDICINE PLACER exploration pits (Jungst), formerly Dreamdust	**Proposal for 2008 in analysis – possible June 2008 implement/previous POO 1996–2005, 2007**	NFS lands	Less than 5 acres distrurbance	X					X					
Raven (aka St. Paul or Zollars Saint Paul Group) (above Snowshoe Creek – D. Shaw) underground mine & prospects	1955–? Adit closure – 2008 or 2009; POO 1990–1992	NFS lands	Approx 60 acres claimed/3 open adits, waste rock, mine road approx 2,000 feet	X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Silvertip (above Cherry Creek)	1926–?	NFS lands	Approx 60 acres of claims/portals, waste rock, less than 5 acres	X										
Libby Creek Recreational Gold Panning Area/primitive camp	Site of historic mining early 1900s–1950s/late 1980s land exchanged to NFS lands for rec. uses	NFS lands	Land designated for this purpose amounts to approx 175 acres	X					X					
Libby Placer Mining Co.–instream placer mining in Libby Creek	1889–1930s/large scale placer mine near 8.2-mile bridge Libby Creek	PVT	Approx 1,200 acre parcel, approx 3 miles of stream	X					X					
Libby Creek Gold Mining Co.	1930s–1940s placer, hydraulic mining Howard Creek, Libby Creek above Howard Creek confluence	NFS lands	Unknown	X					X					
Bolyard Placer – ***see Vaughn/Greenwell, Lost Grouse***, upper Libby Creek – connected to Lost Grouse	1889–1909; 1964 hydraulic mining, sluicing/small scale drifting/POO 1992, 1995, 1996/ **reclamation planned 2008 on Lost Grouse**	NFS lands	Underground workings intercepted by Lost Grouse in 2001 on less than 5-acre disturbance	X					X					
Copper-Iron occurrence	Unknown	NFS lands	Unknown	X										
Copper-lead-iron-manganese occurrence	Unknown	NFS lands	Unknown											
Copper Reward (aka Walker Group or Walker Tunnel) – prospect	Unknown	NFS lands	Caved adits above slope on Big Cherry Creek trail/ less than 5 acres disturbance	X										
Walker – ***see Copper Reward***														
Fairbuilt prospect	Unknown	NFS lands	One adit 335 feet; status unknown	X					X					
Comet Placer – instream placer mining (aka Deadwood/Hogun)/Noranda Minerals/MMI	1908–1916/1931 hydraulic mining near mouth of Little Cherry Creek	PVT	Site of hydraulic mining; approx 350 acres in patented claims	X					X					
Red Gulch Placer (part of Comet) – ***see Comet Placer***		PVT												
Grizzly/Missouri/McDonald on Leigh Creek near bridge and just above confluence with Big Cherry Creek	Pre-1948 adits/closures planned 2008 or 2009	NFS lands	3 (?) adits/minor surface disturbances, overgrown	X										
Glacier Silver/Lead aka Lukins/Hazel Mine – **currently being subdivided**	1910–1964, extensive underground mine, mill/**subdivision planned-date unknown**	PVT	Approx 700 acres/ 10,500 feet of workings, site of 325 T/day mill				X							

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Loyal – ***see Luken Hazel*** (aka Shaughnessy Hill)		PVT					X							
Double Mac, north side Granite Creek near Victor Empire – prospect	Early 1900s	NFS lands	2 short caved adits/minor surface disturbance				X							
Victor Empire (north side of Granite Creek near trailhead) inactive – mining, milling	1908–1937/**adit closure complete 2007**	NFS lands	200 acres of mining claims, surface disturbances overgrown				X							
Silver Mountain Mine (south side Granite Creek)	1910–1950s/mill, flume, 3 adits, lower one open, **adit closure planned 2008**	NFS lands	Approx 150 acres of claims/surface disturbance less than 5 acres				X							
Mountain Rose aka Granite Creek (south side Granite Creek) see Silver Mountain		NFS lands					X							
Prospect Hill Mineral Exploration (explore existing portal)	**In analysis – POO due winter 2008**/Herbert mine – 1930s/Orvana POO exploration 1990–1998	NFS lands	20-acre claim/less than 5 acres surface disturbance for minerals exploration/use/ minor reconstruct. of mine road .5 mile, approx less than 1 mile road construction				X	X						
Prospect Hill Private land access – easement and road construction	**In analysis – Special Use permit spring 2008**	PVT	20-acre parcel; less than 1 mile road construction to access; use/minor reconstruct. of mine road, approx .5 mile				X	X						
D&W group – inactive/ prospect	1930s adits on south side of Prospect Creek includes Ida V. and pits	NFS lands	Caved adits/less than 5 acres/ mining claim inactive				X							
Demonstrator Prospect	1930s	NFS lands	Small cuts – minor disturbance near Herbert Mine				X							
Denver #1 and #2	1930s	NFS lands	Pits, minor, near Herbert Mine				X							

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Gravel pit D5-8/in reclamation status/Prospect Creek Pit	Inactive since mid-1980s ? at least – reclamation status	NFS lands	0.25 acre				X							
Gravel pit D5-21 – Deep-Granite pit reclamation status	Inactive since mid-1980s ? at least – reclamation status	NFS lands	0.1 acre				X							
Gravel pit D5-12/Big Cherry Creek Pit/**Active** status	**Active** at least since prior to 1994	NFS lands	2.5 acres				X							
Gravel pit D5-7/Deep Creek Pit/reclamation	Inactive at least since mid-1980s	NFS lands	0.5 acre				X							
Noxious Weeds Management														
1997 KNF Herbicide Weed Control Plan EA	2002	USFS	Acres	28.25		5.25	12.5							
1997 KNF Herbicide Weed Control Plan EA	2003	USFS	Acres	67.25		22.75	4.5							
1997 KNF Herbicide Weed Control Plan EA	2004	USFS	Acres	47.5		32.75	156							
1997 KNF Herbicide Weed Control Plan EA	2005	USFS	Acres	82.3		39.27	7							
1997 KNF Herbicide Weed Control Plan EA	2006	USFS	Acres	51.3		93.7	24.1							
KNF Herbicide Weed Control Plan EA 2002	2002	USFS	Acres sprayed		62									
KNF Herbicide Weed Control Plan EA 2002	2003	USFS	Acres sprayed		0									
KNF Herbicide Weed Control Plan EA 2002	2004	USFS	Acres sprayed		10									
KNF Herbicide Weed Control Plan EA 2002	2005	USFS	Acres sprayed		4									
KNF Herbicide Weed Control Plan EA 2002	2006	USFS	Acres sprayed		10.5									
Pre-commercial Thinning														
Pre-commercial Thin	1950s	FS	0 ACRES	X										
Pre-commercial Thin	1960s		79	X										
Pre-commercial Thin	1970s		557	X										
Pre-commercial Thin	1980s		597	X										
Pre-commercial Thin	1990s		1713	X										
Pre-commercial Thin	2000-2006		403	X										
Pre-commercial Thin	1950s	FS	0			X								
Pre-commercial Thin	1960s		980			X								
Pre-commercial Thin	1970s		312			X								
Pre-commercial Thin	1980s		152			X								
Pre-commercial Thin	1990s		51			X								
Pre-commercial Thin	2000-2006		0			X								
Pre-commercial Thin	1950s	FS	0				X							
Pre-commercial Thin	1960s		502				X							

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Pre-commercial Thin	1970s		1083				X							
Pre-commercial Thin	1980s		264				X							
Pre-commercial Thin	1990s		891				X							
Pre-commercial Thin	2000-2006		271				X							
Prescribed Burning														
Fuels Treatment	1950s	FS	0	X										
Fuels Treatment	1960s		6	X										
Fuels Treatment	1970s		1455	X										
Fuels Treatment	1980s		799	X										
Fuels Treatment	1990s		760	X										
Fuels Treatment	2000-2006		0	X										
Fuels Treatment	1950s	FS	0			X								
Fuels Treatment	1960s		0			X								
Fuels Treatment	1970s		0			X								
Fuels Treatment	1980s		255			X								
Fuels Treatment	1990s		129			X								
Fuels Treatment	2000-2006		0			X								
Fuels Treatment	1950s	FS	0				X							
Fuels Treatment	1960s		00				X							
Fuels Treatment	1970s		75				X							
Fuels Treatment	1980s		258				X							
Fuels Treatment	1990s		275				X							
Fuels Treatment	2000-2006		130				X							
Recreational Building Maintenance														
Toilets		FS		2	7	2	1							
Pavillion		FS			2		1							
Pump House		FS		1										
Storage Shed		FS		1										
Lookout Tower		FS				1	1							
Old Cabin		FS				1								
Radio Buildings		Non-FS				1	1							
Many Private Buildings in all 4 Planning Subunits. Several buildings associated with old mining claims.														
Road Construction, Maintenance, and Obliteration														
Silver Butte Phase RAC 2	2007	FS	7.5 miles			X								
West Fisher Aggregate Placement	2007	FS/PC	4.2 miles			X								
Libby Creek Bridge Approach Paving	2007	FS	8 Bridges	X										
West Fisher RAC	2007	FS	1.5 miles			X								
Libby Creek ERFO	2008	FS	Washout site	X										
Big Cherry Millsite Cleanup	2007	FS	Hazmat cleanup site				X							
Snowshoe Cleanup	2008	State/Private	Hazmat cleanup site	X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Big Cherry Bridge ERFO	2007	FS	1 Bridge Repair from flood				X							
Midas Creek Fish Passage	2007	FS	Culvert replacement	X										
Rd 6205 BMP	2007	FS	BMP work on 1 mile	X										
NF Bull River ERFO	2007	FS	Washout site		X									
SF Bull River ERFO	2007	FS	Washout site		X									
Routine Road Mtce is likely to occur on many of the roads	Annually	FS		X	X	X	X							
Routine road maintenance is likely to occur on open roads in Silverfish subunit (Miller West Fisher EIS).														
Special Forest Products														
Huckleberry gathering sesonal commercial permit	2002	FS	Unknown	X	X	X	X	X	X	X				
Huckleberry gathering sesonal commercial permit	2005	FS	Unknown	X	X	X	X	X	X	X				
Special Use Permits														
FRTA Road – PCTC 401371	1982		8.0 ac.			X								
FRTA Road – PCTC 401373	1983		4.67 ac.			X								
FRTA Road – PCTC 497813	1965		22.0 ac.			X								
FRTA Road – PCTC 497817	1964		12.29 ac			X								
FRTA Road – PCTC 401727	1979		12.08 ac.			X								
FRTA Road – PCTC 497860	1982		46.0 ac.			X								
FRTA Road – PCTC 497861	1982		1.52 ac.			X								
THR074 – Sp. Use Road	1994		0.14 ac.				X							
CAB062 – Water Qlty Station - Monitoring	1993		1 – Permit		X									
496801 – FRTA Road	1986		10.90 ac		X									
495601 – FRTA Road	1986		9.12 ac		X									
095502 – Powerline (BPA)	1950		1 - permit		X									
CAB049 – Sp Use Road	1980		1.61 ac		X									
095506 – Passive Reflector	1977		1 - permit		X									
CAB060 – Sp.Use Road	1980		1.61 ac.		X									
Outfitter & Guide	?		2 -Permit		X									
CAB064 – Water Transmission Pipeline <12”	1992		0.05 ac		X									
CAB048 – Water Transmission Pipeline <12”	1957		0.07 ac		X									
CAB116 - Water Transmission Pipeline <12”	1991		0.10 ac											
496607 – Powerline	1985		91.40 ac.		X									
510401 – FLPMA Easement	1993		0.09 ac		X									
CAB028 – Water Transmission Pipeline <12”	1981		0.41 ac.		X									

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
CAB111 – FLPMA Easement	2006		0.56 ac		X			X						
KNF006 – FRTA Road	2002		7.85 ac.		X			X						
LIB022 – FRTA Road	2002		112.0 ac.	X			X	X						
LIB094 – Water Conveyance system easement	1927		1.63	X				X						
LIB129 - Water Transmission Pipeline <12”	1963		0.13 ac.	X				X						
507601 – FLPMA Easement	1999		1.65 ac	X				X						
195222 – DOT Easement (2)	1984		130.10	X				X						
LIB135 – Sp Use Road	1996		0.39 ac	X				X						
533601 – Irrigation Water Ditch	1983		2.20 ac.	X				X						
529801 – Sp Use Road	1981		0.63 ac.	X					X					
LIB021 – FRTA Road	2000		3.84 ac.				X							
502201 – FLPMA Easement	1998		0.97 ac				X		X					
511901 – Sp Use Road	1998		3.38 ac.				X		X					
LIB050 – Target Range	1978		12.0 ac				X							
LIB090 – Sp Use Road	1983		1.09 ac				X							
LIB128 – Sp Use Road	1996		0.34 ac.				X		X					
100134 – FRTA Road	1983		8.03 ac				X							
100144 – FRTA Road	1977		0.79 ac				X		X					
100137 – FRTA Road	1981		6.15 ac				X			X				
100138 – FRTA Road	1981		7.84 ac				X			X				
101001 – Water Diversion weir	1986		1.29 ac				X			X				
405706 – Passive Reflector	1966		1 permit				X			X				
300301 – Broadcast Translator/Low Power	1996		1 permit				X			X				
100152 – FRTA Road	1994		8.18 ac.				X			X				
KNF014 – Powerline (BPA)	1950		1 - permit				X			X				
Trail Mtce-Secondary	2004	FS	0.00											
Trail Mtce – Way	2004	FS	22.85 miles			X				X				
Timber Sales														
Regeneration Harvests	1950s	FS	127 Acres	X										
Regeneration Harvests	1960s		1220	X										
Regeneration Harvests	1970s		3501	X										
Regeneration Harvests	1980s		2244	X										
Regeneration Harvests	1990s		826	X										
Regeneration Harvests	2000-2006		27	X										
Intermediate Harvests	1950s	FS	56 Acres	X										
Intermediate Harvests	1960s		608	X										
Intermediate Harvests	1970s		1312	X										
Intermediate Harvests	1980s		879	X										
Intermediate Harvests	1990s		850	X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Intermediate Harvests	2000-2006		33	X										
All PVT Harvests	1950s	Private	509 Acres	X										
All PVT Harvests	1960s		139	X										
All PVT Harvests	1970s		204	X										
All PVT Harvests	1980s		1052	X										
All PVT Harvests	1990s		1295	X										
All PVT Harvests.	2000-2006		232	X										
Sum PVT Regen.			1617 Acres	X										
Sum PVT Intermed.			1814 Acres	X										
Regeneration Harvests	1950s	FS	Acres			X								
Regeneration Harvests	1960s		47			X								
Regeneration Harvests	1970s		97			X								
Regeneration Harvests	1980s		1004			X								
Regeneration Harvests	1990s		170			X								
Regeneration Harvests	2000-2006		0			X								
Intermediate Harvests	1950s	FS	0 Acres			X								
Intermediate Harvests	1960s		1549			X								
Intermediate Harvests	1970s		647			X								
Intermediate Harvests	1980s		536			X								
Intermediate Harvests	1990s	FS	384			X								
Intermediate Harvests	2000-2006		0			X								
All PVT Harvests	1950s	PVT	41 Acres			X								
All PVT Harvests	1960s		0			X								
All PVT Harvests	1970s		0			X								
All PVT Harvests	1980s		2561			X								
I All PVT Harvests	1990s		426			X								
	2000-2006		566			X								
Sum PVT Regen			1808			X								
Sum PVT Intermed.			1786			X								
Regeneration Harvests	1950s	FS	0				X							
Regeneration Harvests	1960s		499				X							
Regeneration Harvests	1970s		379				X							
Regeneration Harvests	1980s		1502				X							
Regeneration Harvests	1990s		1221				X							
Regeneration Harvests	2000-2006		27											
IntermediateHarvests	1950s	FS	0 Acres				X							
IntermediateHarvests	1960s		105											
IntermediateHarvests	1970s		21											
IntermediateHarvests	1980s		579											
IntermediateHarvests	1990s	FS	686				X							
IntermediateHarvests	2000-2006		567											
All PVT Harvests	1950s	PVT	0 Acres				X							
All PVT Harvests	1960s		488				X							
All PVT Harvests	1970s		708				X							

Planning Subunit and LAU: C – Crazy, R – Rock, S – Silverfish, T – Treasure, W – West Fisher

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
All PVT Harvests	1980s		3196				X							
All PVT Harvests	1990s		1248				X							
All PVT Harvests	2000-2006		615				X							
Sum PVT Regen			3097				X							
Sum PVT Intermed.			3158				X							
BABY BEAR BUGS	1987		111	X										
BARE DOWN FUELWOOD	1996		11	X										
BARE FUEL	1986		27	X										
BEAR-POORMAN WP SALV	1990		86	X										
BEAR??	1982		57	X										
BIG CHERRY	1994		78	X										
BUGGY BEAR PC	1984		37	X										
BUNYAN BUGS	1988		55	X										
BUNYAN PULP	1997		13	X										
CAMPGROUND BUGS	1988		25	X										
CENTRAL PLACER S.T.	1985		45	X										
CRAZY BUGS	1985		20	X										
CRAZY CAB SALV	1998		126	X										
CRAZYMAN BLOWOUT	1982		27	X										
CRAZYMAN BUGS	1987		11	X										
CRAZYMAN SALE	1974		123	X										
CRAZYMAN SALE	1975		156	X										
CRAZYMAN SALE	1976		797	X										
GOLDIELOCKS P C	1986		25	X										
GRANITE	1987		115	X										
GRANITE	1988		184	X										
HOODOO	1982		50	X										
HOODOO	1983		59	X										
HOODOO	1987		186	X										
HOODOO	1988		413	X										
HOODOO	1989		110	X										
HOODOO	1990		412	X										
HOODOO	1991		326	X										
HOODOO	1992		16	X										
HOODOO SALE	1978		12	X										
HORSE BUGGY PC	1984		9	X										
HORSE BUGGY PC	1986		7	X										
HORSE CABLE	1985		198	X										
HORSE CABLE	1986		267	X										
HORSE CABLE	1987		130	X										
HORSE CABLE	1988		171	X										
HORSE CABLE	1989		34	X										
HORSE CABLE CLEANUP	1989		100	X										

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
HORSE CABLE CLEANUP	1991		12	X										
HOWARD W. FISHER	1978		93	X										
HOWARD W. FISHER	1984		38	X										
JUST RIGHT PC	1988		42	X										
LEIGH CR. BUGS	1989		99	X										
LIBBY CR SEED TREE	1989		125	X										
LIBBY CREEK	1973		67	X										
LIBBY CREEK	1976		134	X										
LIBBY CREEK STR	1982		16	X										
LIBBY-HORSE BLOWDOWN	1990		15	X										
LITTLE CHERRY BUG	1989		39	X										
MAMA BEAR BUGS	1987		133	X										
MIDAS	1990		160	X										
MIDAS	1991		258	X										
MIDAS BLOWDOWN	1998		81	X										
MIDAS SEED TREE	1989		194	X										
ONCE MORE SALVAGE	1991		29	X										
PAPA BEAR BUGS	1987		108	X										
PAUL BUNYAN P.C.	1986		81	X										
PAUL BUNYAN P.C.	1987		40	X										
POOR LITTLE RAMSEY	1982		42	X										
SKI TRAIL SALVAGE	1990		12	X										
SKIER DOWN SALV	1997		130	X										
SMEARL LITTLE CHERRY	1970		89	X										
SMEARL LITTLE CHERRY	1976		63	X										
SMEARL LITTLE CHERRY	1978		413	X										
SMEARL LITTLE CHERRY	1980		25	X										
SMEARL LITTLE CHERRY	1981		25	X										
SMEARL LITTLE CHERRY	1982		287	X										
SNOWSHOE	2006		19	X										
SNOWSHOE PLANT BUGS	1991		3	X										
TREASURE 2 (STEWARDS)	2004		22	X										
TREASURE 2 (STEWARDS)	2005		8	X										
WHO DOWN SALVAGE	1993		231	X										
WILLIAMS MCMILLIAN	1981		39	X										
WINDY BEAR SALV	1997		89	X										
CEDAR CR POSTS #1	1992		11				X							
CEDAR CR POSTS #2	1992		16				X							
CEDAR CR POSTS #3	1991		6				X							
DEEP GRANITE	1979		290				X							
DEEP GRANITE	1980		303											

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
FLOWER BUGS	1987		11				X							
FLOWER CEDAR	1980		61				X							
FLOWER CEDAR	1981		114				X							
FLOWER CEDAR	1982		18				X							
FLOWER CEDAR	1984		251				X							
FLOWER CEDAR	1985		85				X							
FLOWER CEDAR	1986		183				X							
FLOWER CEDAR	1988		10				X							
FLOWER-CEDAR ST	1990		55				X							
GOLD DIGGER BUGS	1993		79				X							
GRANITE	1986		75				X							
GRANITE	1987		162				X							
GRANITE	1988		16				X							
GRANITE BRUSH BUGS	1987		24				X							
GRANITE BRUSH BUGS	1990		140				X							
GRANITE BUGS	1986		32				X							
GRANITE CREEK BUGS	1988		102				X							
GUAGING STATION	1982		26				X							
INTAKE BUGS	1989		11				X							
INTAKE BUGS	1990		92				X							
ISOLATED BUGS	1987		20				X							
MAMA BEAR BUGS	1987		31				X							
NO CREEK BUGS	1987		74				X							
NO RESALE	1986		40				X							
NO RESALE	1987		13				X							
PARMENTER BLOWDOWN	1999		61				X							
PARMENTER HILL BUGS	1988		28				X							
PARMENTER TRASPASS	1989		7				X							
PROSPECT PARMENTER	1994		315				X							
PROSPECT PARMENTER	1995		22				X							
PROSPECT PARMENTER	1996		249				X							
PROSPECT PARMENTER	1997		96				X							
PROSPECT PARMENTER	1998		45				X							
PROSPECT PARMENTER	1999		108				X							
PROSPECT PEST 1	1989		12				X							
SCENERY SALVAGE	1997		36				X							
SNOWSHOE PLANT BUGS	1991		172				X							
SNOWSHOE PLANT BUGS	1992		109				X							
SNOWSHOE ROAD BUGS	1990		314				X							
SOUTH FLOWER BUGS	1990		31				X							
TREASURE 1 (STEWARDS	2003		594				X							
WILLIAMS MCMILLAN	1981		54				X							
WILLIAMS MCMILLAN	1982		113				X							

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
CHECKERBOARD LE	1986		17			X								
CHECKERBOARD LE	1987		33			X								
CHECKERBOARD LE	1992		72			X								
CHECKERBOARD LE	1993		81			X								
CHECKERBOARD LE	1994		55			X								
CORRAL SALVAGE	1997		50			X								
CORRAL SALVAGE	1998		50			X								
HORSE CABLE	1987		18			X								
HORSE CABLE	1988		151			X								
HORSE CABLE	1989		139			X								
HORSE CABLE	1990		59			X								
HORSE CABLE	1991		359			X								
HOWARD W. FISHER	1976		61			X								
HOWARD W. FISHER	1977		15			X								
HOWARD W. FISHER	1978		72			X								
HOWARD W. FISHER	1980		12			X								
MIDAS TRESPASS	1993		13			X								
MILLER FIRE SALVAGE	1993		27			X								
MILLER POST & POLE	1987		10			X								
MILLER POST & POLE	1990		9			X								
MILLER POST & POLE	1991		6			X								
MILLER POST & POLE	1992		7			X								
MILLER STUD P.C.	1986		33			X								
RED BATTON PC	1985		143			X								
SWAMP SCHRIEBER	1989		15			X								
TEETERS BUGS P.C.	1985		47			X								
TEETERS BUGS P.C.	1986		15			X								
TEETERS BUGS RS	1985		26			X								
TEETERS BUGS RS	1987		112			X								
TRAIL CR. BLOWDOWN	1987		8			X								
TRAIL CR. BLOWDOWN	1988		71			X								
TRAIL CREEK	1986		287			X								
TRAIL CREEK	1987		14			X								
WEST FISHER	1978		472			X								
WEST FISHER	1980		27			X								
WEST FISHER	1982		162			X								
WEST FISHER SEED	1988		116			X								
Trail Construction, Maintenance, and Obliteration														
Rock Lake trail # 935	Yearly Mtce.	FS	4 miles		X				X					
Moran Basin Tr #993	Yearly Mtce.	FS	3 miles		X				X					
Engle Pk Tr. # 932	Yrly mtce.	FS	4.5 miles		X				X					
Trail Mtce – Mainline	2006	FS	31.24 miles				X	X						
Trail Mtce-Secondary	2006	FS	2.92 miles				X	X						
Trail Mtce – Way	2006	FS	1.58 miles				X	X						

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
Trail Mtce – Mailine	2005	FS	31.24 miles				X	X						
Trail Mtce-Secondary	2005	FS	8.42 miles				X	X						
Trail Mtce – Way	2005	FS	4.96 miles				X	X						
Trail Mtce - Mainline	2004	FS	31.24 miles				X	X						
Trail Mtce-Secondary	2004	FS	3.75 miles				X	X						
Trail Mtce – Way	2004	FS	20.17 miles				X	X						
Trail Mtce – Mainline	2006	FS	7.07 miles	X					X					
Trail Mtce-Secondary	2006	FS	0.00											
Trail Mtce – Way	2006	FS	18.87 miles	X					X					
Trail Mtce – Mainline	2005	FS	7.07 miles	X					X					
Trail Mtce-Secondary	2005	FS	0.00											
Trail Mtce – Way	2005	FS	0.00											
Trail Mtce – Mainline	2004	FS	7.07 miles	X					X					
Trail Mtce-Secondary	2004	FS	0.00											
Trail Mtce – Way	2004	FS	3.20 miles	X					X					
Trail Mtce – Mainline	2006	FS	10.37 miles			X				X				
Trail Mtce-Secondary	2006	FS	7.57 miles			X				X				
Trail Mtce – Way	2006	FS	59.72 miles			X				X				
Trail Mtce – Mainline	2005	FS	10.37 miles			X				X				
Trail Mtce-Secondary	2005	FS	2.91 miles			X				X				
Trail Mtce – Way	2005	FS	26.06 miles			X				X				
Trail Mtce – Mainline	2004	FS	10.37 miles			X				X				
Trail Mtce-Secondary	2004	FS	0.00											
Trail Mtce – Way	2004	FS	22.85 miles			X				X				
No mention of specific Trail Construction, Maintenance, or Obliteration projects in Silverfish Subunit.														
Tree Planting														
Tree Planting	1915	FS	478 ACRES	X										
	1950s		0	X										
	1960s		38	X										
	1970s		3666	X										
	1980s		1905	X										
	1990s		2107	X										
	2000-2006		24	X										
SILVERFISH	1950s	FS	0			X								
	1960s		112			X								
	1970s		26			X								
	1980s		499			X								
	1990s		343			X								
	2000-2006		0			X								
TREASURE	1915-1948	FS	1622 ACRES				X							
	1950s		0				X							
	1960s		0				X							
	1970s		190				X							
	1980s		812				X							

Activity/Project	Year	Ownership	Impact Unit of Measure (Acres, miles, number of permits)	Planning Subunit				BMU			BORZ	LAU		
				C	R	S	T	2	5	6	Cabinet Face	C	R	W
	1990s		1088				X							
	2000-2006		192				X							
Watershed Restoration														
Upper Libby Creek Cleveland Project	2002	FS and private	3,200 feet of stream and riparian area	X					X					
Wildfires														
			Number of fires			X								
Wildfire	1960-1969		9			X								
Wildfire	1970-1979		15			X								
Wildfire	1980-1989		20			X								
Wildfire	1990-1999		18			X								
Wildlife Habitat Improvement														
Miller Creek Wildlife Habitat Improvement Burn	1998	USFS	1, 300 acres			X								
Plum Creek Native Fish Habitat Conservation Plan	2000	Plum Creek	1.6 million acres											

Appendix F—Supplemental Macroinvertebrate Data

Appendix F: Macroinvertebrate Data, 1988- 2005

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Exact site locations are uncertain from some sources; methods differ between studies and years as well.

Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
East Fork Rock Creek	Aug-85	31	23	74	62	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Oct-85	20	15	75	96	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Oct-85	28	21	75	91	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Apr-86	20	18	90	93	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Aug-86	27	24	89	95	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Aug-86	31	22	71	84	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Oct-86	22	18	82	59	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Apr-87	20	19	95	98	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Aug-87	27	23	85	94	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Oct-87	27	24	89	97	NC	NC	NC	NC	USFS and Montana DEQ, 2001
Bear Creek	Aug-88	38	17	45	77	4.06	0.9158	0.7727	83	Western Resource Development Corp. 1989a
Bear Creek	Aug-88	37	19	51	73	4.12	0.9243	0.7912	84	Western Resource Development Corp. 1989a
Bear Creek	Aug-88	43	29	67	77	4.32	0.9266	0.7969	105	Western Resource Development Corp. 1989a
East Fork Rock Creek	Aug-88	26	23	88	98	NC	NC	NC	NC	USFS and Montana DEQ, 2001
East Fork Rock Creek	Aug-88	26	16	62	87	3.78	0.9050	0.8050	92	Western Resource Development Corp. 1989a
East Fork Rock Creek	Aug-88	38	21	55	56	4.27	0.9153	0.8128	89	Western Resource Development Corp. 1989a
East Fork Rock Creek	Aug-88	42	20	48	46	4.32	0.9242	0.8020	86	Western Resource Development Corp. 1989a
Libby Creek Reach Between Ramsey and Poorman Creeks	Aug-88	46	21	46	40	3.90	0.8920	0.7195	78	Western Resource Development Corp. 1989a
Libby Creek Reach Near Bear Creek confluence	Aug-88	49	28	57	66	3.87	0.8987	0.6900	87	Western Resource Development Corp. 1989a
Libby Creek Reach Near Midas Creek Confluence	Aug-88	43	24	56	68	3.99	0.9091	0.7349	87	Western Resource Development Corp. 1989a
Libby Creek Reach nr Howard Creek confluence	Aug-88	41	21	51	76	4.06	0.9106	0.7580	86	Western Resource Development Corp. 1989a
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-88	49	27	55	57	4.08	0.9180	0.7262	83	Western Resource Development Corp. 1989a
Little Cherry Creek	Aug-88	48	23	48	32	4.02	0.8747	0.7193	85	Western Resource Development Corp. 1989a
Little Cherry Creek	Aug-88	43	27	63	87	4.38	0.9214	0.8076	97	Western Resource Development Corp. 1989a
Poorman Creek	Aug-88	47	23	49	80	4.19	0.8936	0.7538	79	Western Resource Development Corp. 1989a
Poorman Creek	Aug-88	50	27	54	76	4.48	0.9318	0.7932	91	Western Resource Development Corp. 1989a

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Ramsey Creek	Aug-88	40	22	55	67	4.04	0.8944	0.7593	83	Western Resource Development Corp. 1989a
Ramsey Creek	Aug-88	44	22	50	65	4.26	0.9138	0.7802	82	Western Resource Development Corp. 1989a
Ramsey Creek	Aug-88	42	18	43	65	4.30	0.9332	0.7967	92	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Aug-88	37	21	57	78	4.03	0.9132	0.7745	95	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Aug-88	40	21	53	56	4.20	0.9223	0.7893	90	Western Resource Development Corp. 1989a
Bear Creek	Oct-88	40	26	65	91	3.75	0.8836	0.7050	99	Western Resource Development Corp. 1989a
Bear Creek	Oct-88	47	32	68	91	3.95	0.8950	0.7112	114	Western Resource Development Corp. 1989a
Bear Creek	Oct-88	34	23	68	94	3.98	0.9132	0.7821	107	Western Resource Development Corp. 1989a
East Fork Rock Creek	Oct-88	46	20	43	22	1.89	0.4817	0.3415	75	Western Resource Development Corp. 1989a
East Fork Rock Creek	Oct-88	41	24	59	64	4.37	0.8164	0.8164	99	Western Resource Development Corp. 1989a
East Fork Rock Creek	Oct-88	35	24	69	86	4.39	0.9423	0.8567	104	Western Resource Development Corp. 1989a
Libby Creek Reach Between Ramsey and Poorman Creeks	Oct-88	35	25	71	91	3.70	0.8709	0.7222	115	Western Resource Development Corp. 1989a
Libby Creek Reach Near Bear Creek confluence	Oct-88	38	25	66	94	3.54	0.8642	0.6753	106	Western Resource Development Corp. 1989a
Libby Creek Reach Near Midas Creek Confluence	Oct-88	32	23	72	96	3.61	0.8843	0.7214	117	Western Resource Development Corp. 1989a
Libby Creek Reach nr Howard Creek confluence	Oct-88	21	16	76	95	2.96	0.7908	0.6740	126	Western Resource Development Corp. 1989a
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-88	43	25	58	92	3.89	0.8962	0.7171	96	Western Resource Development Corp. 1989a
Little Cherry Creek	Oct-88	40	26	65	66	4.08	0.9106	0.7662	104	Western Resource Development Corp. 1989a
Little Cherry Creek	Oct-88	51	30	59	71	4.46	0.9355	0.7865	83	Western Resource Development Corp. 1989a
Poorman Creek	Oct-88	49	31	63	88	4.02	0.8956	0.7167	96	Western Resource Development Corp. 1989a
Poorman Creek	Oct-88	43	25	58	87	4.08	0.8999	0.7527	95	Western Resource Development Corp. 1989a

Appendix F: Macroinvertebrate Data, 1988- 2005

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Ramsey Creek	Oct-88	34	24	71	79	3.73	0.8650	0.7327	106	Western Resource Development Corp. 1989a
Ramsey Creek	Oct-88	30	21	70	95	3.78	0.9035	0.7700	111	Western Resource Development Corp. 1989a
Ramsey Creek	Oct-88	33	17	52	74	3.83	0.8698	0.7588	102	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Oct-88	33	17	52	79	3.37	0.8316	0.6682	84	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Oct-88	38	27	71	95	3.69	0.8713	0.7031	116	Western Resource Development Corp. 1989a
Bear Creek	Apr-89	49	27	55	90	4.01	0.9064	0.7139	88	Western Resource Development Corp. 1989a
Bear Creek	Apr-89	40	21	53	64	4.09	0.9155	0.7684	83	Western Resource Development Corp. 1989a
Bear Creek	Apr-89	36	18	50	64	4.28	0.9272	0.8277	86	Western Resource Development Corp. 1989a
East Fork Rock Creek	Apr-89	37	23	62	91	3.07	0.7637	0.5885	89	Western Resource Development Corp. 1989a
East Fork Rock Creek	Apr-89	50	18	36	39	3.68	0.8862	0.6526	66	Western Resource Development Corp. 1989a
East Fork Rock Creek	Apr-89	NS	NS	NS	NS	NS	NS	NS	NS	Western Resource Development Corp. 1989a
Libby Creek Reach Between Ramsey and Poorman Creeks	Apr-89	42	24	57	62	4.18	0.9205	0.7757	87	Western Resource Development Corp. 1989a
Libby Creek Reach Near Bear Creek confluence	Apr-89	47	30	64	86	4.10	0.9005	0.7390	99	Western Resource Development Corp. 1989a
Libby Creek Reach Near Midas Creek Confluence	Apr-89	37	20	54	70	3.98	0.8962	0.7635	86	Western Resource Development Corp. 1989a
Libby Creek Reach nr Howard Creek confluence	Apr-89	33	17	52	77	3.69	0.8760	0.7317	82	Western Resource Development Corp. 1989a
Libby Creek Reach Upstream of Crazyman Creek Confluence	Apr-89	51	27	53	81	4.08	0.8761	0.7198	83	Western Resource Development Corp. 1989a
Little Cherry Creek	Apr-89	36	20	56	35	3.98	0.9025	0.7708	83	Western Resource Development Corp. 1989a
Little Cherry Creek	Apr-89	50	24	48	33	4.03	0.8648	0.7133	77	Western Resource Development Corp. 1989a
Poorman Creek	Apr-89	43	24	56	41	4.35	0.9325	0.8022	81	Western Resource Development Corp. 1989a
Poorman Creek	Apr-89	51	27	53	71	4.37	0.9232	0.7711	85	Western Resource Development Corp. 1989a

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Ramsey Creek	Apr-89	46	24	52	64	4.00	0.8990	0.7250	100	Western Resource Development Corp. 1989a
Ramsey Creek	Apr-89	55	28	51	53	4.04	0.9018	0.6981	80	Western Resource Development Corp. 1989a
Ramsey Creek	Apr-89	46	27	59	52	4.26	0.9267	0.7710	93	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Apr-89	39	22	56	63	4.03	0.9086	0.7625	90	Western Resource Development Corp. 1989a
Uppermost Libby Creek Reach	Apr-89	38	19	50	65	4.15	0.9161	0.7917	79	Western Resource Development Corp. 1989a
Libby Creek Reach Immediately Upstream of Falls	Apr-90	22	14	64	92	3.23	0.8493	0.7256	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Upstream of Crazyman Creek Confluence	Apr-90	24	19	79	61	3.61	0.8771	0.7678	NC	Western Technology and Engineering, Inc. 1991
Little Cherry Creek	Apr-90	26	18	69	87	3.17	0.8107	0.6748	NC	Western Technology and Engineering, Inc. 1991
Poorman Creek	Apr-90	24	19	79	87	2.81	0.7358	0.6128	NC	Western Technology and Engineering, Inc. 1991
Ramsey Creek	Apr-90	22	19	86	94	2.97	0.7880	0.6567	NC	Western Technology and Engineering, Inc. 1991
Uppermost Libby Creek Reach	Apr-90	16	14	88	96	2.99	0.8289	0.7465	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Immediately Upstream of Falls	Aug-90	26	18	69	89	3.60	0.8918	0.7654	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-90	33	24	73	96	3.37	0.8549	0.6684	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Upstream of Little Cherry Creek	Aug-90	27	22	81	95	3.37	0.8641	0.7100	NC	Western Technology and Engineering, Inc. 1991
Poorman Creek	Aug-90	24	21	88	95	3.27	0.8636	0.7136	NC	Western Technology and Engineering, Inc. 1991
Ramsey Creek	Aug-90	30	25	83	88	3.85	0.8893	0.7765	NC	Western Technology and Engineering, Inc. 1991
Uppermost Libby Creek Reach	Aug-90	23	19	83	93	3.26	0.8382	0.7200	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Immediately Upstream of Falls	Oct-90	35	28	80	90	3.28	0.8132	0.6401	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-90	34	27	79	98	2.84	0.7311	0.5589	NC	Western Technology and Engineering, Inc. 1991
Libby Creek Reach Upstream of Little Cherry Creek	Oct-90	34	27	79	98	2.94	0.7873	0.5774	NC	Western Technology and Engineering, Inc. 1991

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Little Cherry Creek	Oct-90	35	28	80	92	3.71	0.8723	0.7227	NC	Western Technology and Engineering, Inc. 1991
Poorman Creek	Oct-90	24	22	92	99	2.58	0.6822	0.5561	NC	Western Technology and Engineering, Inc. 1991
Ramsey Creek	Oct-90	24	19	79	98	2.87	0.7996	0.6265	NC	Western Technology and Engineering, Inc. 1991
Uppermost Libby Creek Reach	Oct-90	27	23	85	95	3.00	0.7733	0.6313	NC	Western Technology and Engineering, Inc. 1991
Bear Creek	May-91	31	26	84	98	3.12	0.8297	0.6301	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Immediately Upstream of Falls	May-91	19	17	89	94	3.19	0.8559	0.7506	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Crazyman Creek Confluence	May-91	34	27	79	95	3.33	0.8366	0.6545	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Little Cherry Creek	May-91	25	19	76	92	3.13	0.8335	0.6740	NC	Western Technology and Engineering, Inc. 1992
Little Cherry Creek	May-91	24	20	83	95	3.37	0.8493	0.7356	NC	Western Technology and Engineering, Inc. 1992
Poorman Creek	May-91	25	22	88	94	3.56	0.8752	0.7668	NC	Western Technology and Engineering, Inc. 1992
Ramsey Creek	May-91	28	23	82	91	3.33	0.8528	0.6922	NC	Western Technology and Engineering, Inc. 1992
Uppermost Libby Creek Reach	May-91	29	22	76	87	3.28	0.8391	0.6745	NC	Western Technology and Engineering, Inc. 1992
Bear Creek	Aug-91	35	28	80	98	2.86	0.7981	0.5570	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Immediately Upstream of Falls	Aug-91	34	27	79	93	3.10	0.8150	0.6085	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-91	35	28	80	93	3.17	0.8158	0.6182	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Little Cherry Creek	Aug-91	33	26	79	93	3.03	0.7947	0.6007	NC	Western Technology and Engineering, Inc. 1992
Little Cherry Creek	Aug-91	24	19	79	91	3.37	0.8593	0.7353	NC	Western Technology and Engineering, Inc. 1992
Poorman Creek	Aug-91	31	24	77	97	2.93	0.8185	0.5913	NC	Western Technology and Engineering, Inc. 1992
Ramsey Creek	Aug-91	33	26	79	96	3.34	0.8607	0.6614	NC	Western Technology and Engineering, Inc. 1992
Uppermost Libby Creek Reach	Aug-91	30	22	73	80	3.45	0.8709	0.7021	NC	Western Technology and Engineering, Inc. 1992

Appendix F: Macroinvertebrate Data, 1988- 2005

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Bear Creek	Oct-91	37	30	81	99	3.24	0.8218	0.6227	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Immediately Upstream of Falls	Oct-91	32	27	84	99	2.17	0.5712	0.4332	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-91	37	31	84	99	2.90	0.7939	0.5567	NC	Western Technology and Engineering, Inc. 1992
Libby Creek Reach Upstream of Little Cherry Creek	Oct-91	36	31	86	99	3.22	0.8396	0.6234	NC	Western Technology and Engineering, Inc. 1992
Little Cherry Creek	Oct-91	38	32	84	87	3.85	0.8680	0.7329	NC	Western Technology and Engineering, Inc. 1992
Poorman Creek	Oct-91	36	31	86	99	2.92	0.7535	0.5652	NC	Western Technology and Engineering, Inc. 1992
Ramsey Creek	Oct-91	34	29	85	98	3.39	0.8477	0.6656	NC	Western Technology and Engineering, Inc. 1992
Uppermost Libby Creek Reach	Oct-91	39	30	77	97	3.68	0.8913	0.6962	NC	Western Technology and Engineering, Inc. 1992
Bear Creek	Apr-92	38	29	76	84	3.63	0.8724	0.6908	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Immediately Upstream of Falls	Apr-92	35	28	80	73	3.39	0.8370	0.6616	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Crazyman Creek Confluence	Apr-92	29	18	62	84	3.58	0.8866	0.7360	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Little Cherry Creek	Apr-92	39	30	77	86	3.78	0.8895	0.7158	NC	Western Technology and Engineering, Inc. 1993
Little Cherry Creek	Apr-92	35	27	77	74	3.88	0.8990	0.7572	NC	Western Technology and Engineering, Inc. 1993
Poorman Creek	Apr-92	24	20	83	93	3.52	0.8836	0.7670	NC	Western Technology and Engineering, Inc. 1993
Ramsey Creek	Apr-92	36	29	81	72	3.39	0.8439	0.6564	NC	Western Technology and Engineering, Inc. 1993
Uppermost Libby Creek Reach	Apr-92	33	28	85	88	3.26	0.7890	0.6455	NC	Western Technology and Engineering, Inc. 1993
Bear Creek	Aug-92	39	32	82	91	3.73	0.8792	0.7055	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Immediately Upstream of Falls	Aug-92	29	22	76	90	3.48	0.8596	0.7170	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-92	35	27	77	79	3.21	0.8093	0.6254	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Little Cherry Creek	Aug-92	32	26	81	91	3.69	0.8953	0.7378	NC	Western Technology and Engineering, Inc. 1993

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Little Cherry Creek	Aug-92	35	29	83	88	3.38	0.8438	0.6590	NC	Western Technology and Engineering, Inc. 1993
Poorman Creek	Aug-92	24	21	88	95	3.34	0.8664	0.7278	NC	Western Technology and Engineering, Inc. 1993
Ramsey Creek	Aug-92	35	28	80	94	3.87	0.9134	0.7538	NC	Western Technology and Engineering, Inc. 1993
Uppermost Libby Creek Reach	Aug-92	24	18	75	81	3.66	0.9042	0.7978	NC	Western Technology and Engineering, Inc. 1993
Bear Creek	Oct-92	43	35	81	90	3.62	0.8718	0.6650	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Immediately Upstream of Falls	Oct-92	34	29	85	96	3.01	0.7923	0.5919	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-92	38	27	71	91	3.57	0.8650	0.6802	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Upstream of Little Cherry Creek	Oct-92	70	30	43	89	3.98	0.9164	0.7482	NC	Western Technology and Engineering, Inc. 1993
Little Cherry Creek	Oct-92	41	34	83	88	3.81	0.8615	0.7118	NC	Western Technology and Engineering, Inc. 1993
Poorman Creek	Oct-92	42	33	79	88	3.42	0.8499	0.6337	NC	Western Technology and Engineering, Inc. 1993
Ramsey Creek	Oct-92	40	31	78	84	3.61	0.8744	0.6787	NC	Western Technology and Engineering, Inc. 1993
Uppermost Libby Creek Reach	Oct-92	34	27	79	89	3.73	0.8906	0.7334	NC	Western Technology and Engineering, Inc. 1993
Libby Creek Reach Immediately Upstream of Falls	Mar-93	36	29	81	79	3.62	0.8751	0.7006	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Crazyman Creek Confluence	Mar-93	28	21	75	89	3.10	0.7904	0.6439	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Little Cherry Creek	Mar-93	31	28	90	74	3.09	0.8155	0.6240	NC	Western Technology and Engineering, Inc. 1994
Uppermost Libby Creek Reach	Mar-93	33	27	82	52	3.05	0.7539	0.6040	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Immediately Upstream of Falls	Aug-93	37	26	70	78	3.83	0.9047	0.7353	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-93	43	31	72	64	3.44	0.8427	0.6341	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Little Cherry Creek	Aug-93	43	30	70	78	3.24	0.8473	0.5966	NC	Western Technology and Engineering, Inc. 1994
Uppermost Libby Creek Reach	Aug-93	40	29	73	78	3.83	0.8984	0.7202	NC	Western Technology and Engineering, Inc. 1994

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Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Libby Creek Reach Immediately Upstream of Falls	Oct-93	41	31	76	94	3.47	0.8407	0.6474	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-93	53	40	75	90	3.93	0.8909	0.6869	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Upstream of Little Cherry Creek	Oct-93	53	38	72	79	4.03	0.9119	0.7010	NC	Western Technology and Engineering, Inc. 1994
Uppermost Libby Creek Reach	Oct-93	33	27	82	86	3.59	0.8765	0.7115	NC	Western Technology and Engineering, Inc. 1994
Libby Creek Reach Immediately Upstream of Falls	Oct-94	52	43	83	75	3.73	0.8783	0.6555	NC	Western Technology and Engineering, Inc. and Phycologic, 1995
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-94	48	34	71	95	3.21	0.7755	0.5755	NC	Western Technology and Engineering, Inc. and Phycologic, 1995
Uppermost Libby Creek Reach	Oct-94	49	38	78	63	3.46	0.8281	0.6163	NC	Western Technology and Engineering, Inc. and Phycologic, 1995
Bear Creek	Sep-98	32	23	72	86	2.73	0.1033	0.6200	97	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Sep-98	24	17	71	77	2.29	0.1580	0.6240	91	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Sep-98	32	25	78	63	2.42	0.1543	0.5490	84	USFS 2006
West Fisher Creek	Sep-98	28	19	68	72	2.38	0.1377	0.6450	119	USFS 2006
Bear Creek	Aug-99	31	21	68	74	2.63	0.1013	0.7097	87	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Aug-99	28	20	71	74	2.46	0.1407	0.5887	98	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-99	32	22	69	85	2.22	0.2210	0.4390	89	USFS 2006
West Fisher Creek	Aug-99	33	23	70	66	2.61	0.1207	0.5917	120	USFS 2006
Bear Creek	Aug-00	32	24	75	68	2.75	0.0983	0.6500	90	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Sep-00	24	16	67	60	2.26	0.1833	0.5633	92	USFS 2006
Libby Creek Reach Near Midas Creek Confluence	Sep-00	33	25	76	95	NC	NC	NC	NC	Dunnigan et al., 2004, Hoffman et al., 2002
Libby Creek Reach Upstream of Crazyman Creek Confluence	Oct-00	29	22	76	89	2.25	0.1807	0.5537	96	USFS 2006
West Fisher Creek	Oct-00	28	17	61	46	2.26	0.1800	0.5547	111	USFS 2006
Bear Creek	Aug-01	33	23	70	64	2.66	0.1170	0.5710	85	USFS 2006
Fisher River at Highway 2	Aug-01	34	19	56	28	2.62	0.1180	0.5910	84	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Aug-01	39	28	72	56	2.55	0.1480	0.4860	89	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-01	43	28	65	61	2.59	0.1310	0.5370	86	USFS 2006
West Fisher Creek	Aug-01	39	26	67	63	2.83	0.0960	0.5960	122	USFS 2006

Appendix F: Macroinvertebrate Data, 1988- 2005

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Exact site locations are uncertain from some sources; methods differ between studies and years as well.

Stream	Date of Sampling	Taxa Richness	EPT Taxa Richness	EPT Index	Percent EPT Abundance	Shannon-Weaver Diversity Index	Simpson's Diversity Index	Evenness	BCI	Source of Data
Fisher River at Highway 2	Jul-02	10	7	70	67	2.02	0.1300	-	80	USFS 2006
West Fisher Creek	Jul-02	29	19	66	40	2.64	0.1100	0.6210	100	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-02	13	11	85	86	2.25	0.1180	0.8820	111	USFS 2006
Fisher River at Highway 2	Aug-03	16	9	56	33	2.10	0.1910	0.5920	91	USFS 2006
Libby Creek Reach Near Midas Creek Confluence	Aug-03	35	28	80	81	NC	NC	NC	NC	Dunnigan et al., 2004
West Fisher Creek	Aug-03	39	23	59	55	2.79	0.0910	0.6540	105	USFS 2006
Bear Creek	Aug-03	39	29	74	60	3.01	0.0680	0.7150	85	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Aug-03	41	28	68	51	2.47	0.1470	0.5340	82	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Aug-03	34	24	71	73	3.09	0.0580	0.7850	88	USFS 2006
Fisher River at Highway 2	Jul-04	37	25	68	14	1.92	0.2760	0.4530	91	USFS 2006
West Fisher Creek	Jul-04	27	20	74	84	2.51	0.1300	0.5970	125	USFS 2006
Bear Creek	Jul-04	28	22	79	84	2.54	0.1170	0.6440	100	USFS 2006
Libby Creek Reach Immediately Upstream of Falls	Jul-04	30	24	80	95	2.47	0.1350	0.5910	132	USFS 2006
Libby Creek Reach Near Bear Creek confluence	Jul-04	21	18	86	92	2.63	0.0910	0.7720	122	USFS 2006
Libby Creek Reach Upstream of Crazyman Creek Confluence	Jul-04	42	27	64	26	1.75	0.4310	0.2790	83	USFS 2006
East Fork Rock Creek	Sep-05	9	4	44	80	1.53	0.5075	0.4819	NC	Geomatrix 2006a
East Fork Rock Creek	Sep-05	7	2	29	24	1.08	0.5894	0.3831	NC	Geomatrix 2006a
East Fork Rock Creek	Sep-05	11	4	36	3	0.69	0.8313	0.1986	NC	Geomatrix 2006a

Appendix G—Water Quality Mass Balance Calculations

LAD Area Ground Water Flux

ALTERNATIVE 2

Existing Conditions (natural gradient)

	K (ft/day)	i (gradient, unitless)	depth of mixing zone (ft)	width of mixing zone (ft)	cross sectional area (A) (ft^2)
MMC values	1	0.06	56	6860	451388
modified K	0.22				
Ramsey Creek - LAD #1				3040	200032
Ramsey Creek - LAD #2				840	55272
Libby Creek - LAD #2				1040	68432
Poorman Creek - LAD #2				1940	127652
				6860	

Pre-LAD GW Flux:

Q=KiA

27083.28 cubic feet per day

K = 1 ft/day: 0.31 cfs — 140.68 gpm

5958.3216 cubic feet per day

K = 0.22 ft/day: 0.07 cfs — 30.95 gpm

	cubic ft/day	cfs	gpm
Ramsey Creek - LAD #1	2640.4224	0.03	13.72
Ramsey Creek - LAD #2	729.5904	0.01	3.79
Libby Creek - LAD #2	903.3024	0.01	4.69
Poorman Creek - LAD #2	1685.0064	0.02	8.75
			30.95

Maximum total flux (pre-LAD plus LAD application):

Maximum gradient to have ground water mounding to within ~10 bgs at LAD Areas is 0.122 (measured from topo map)

K = 1 ft/day: 55069.336 cubic feet per day; 0.64 cfs; 286.05 gpm

K = 0.22 ft/day: 12115.25392 cubic feet per day; 0.14 cfs; 62.93 gpm

LAD#1	cubic ft/day	cfs	gpm
Ramsey Creek - LAD #1	5368.85888	0.06	27.89
LAD#2			
Ramsey Creek - LAD #2	1483.50048	0.02	7.71
Libby Creek - LAD #2	1836.71488	0.02	9.54
Poorman Creek - LAD #2	3426.17968	0.04	17.80
			62.93

Allowable percolation to ground water without flooding ground surface is:

K = 1 ft/day: 145.37 gpm

K = 0.22 ft/day: 31.98 gpm

	GPM
Ramsey Creek - LAD #1	14.17
Ramsey Creek - LAD #2	3.92
Libby Creek - LAD #2	4.85
Poorman Creek - LAD #2	9.04
	31.98

NOTES: Width is width of LAD area (normal to gw flow direction) + tan 5 degrees x the width added to both sides
Depth is based on avg depth to bedrock of 76' and avg depth to water of 20.'

ALTERNATIVES 3 AND 4

Existing Conditions (natural gradient)

	K (ft/day)	i (gradient, unitless)	depth of mixing zone (ft)	width of mixing zone (ft)	cross sectional area (A) (ft^2)
	1	0.06	56	10150	667870
LAD #1	0.22				
Ramsey Creek				3960	260568
Poorman Creek				720	47376
LAD#2					
Ramsey Creek				2370	155946
Poorman Creek				2300	151340
Libby Creek				800	52640
				10150	

Pre-LAD GW Flux:

Q=Kia

40072.2 cubic feet per day

K = 1 ft/day: 0.46 cfs — 208.15 gpm

8815.884 cubic feet per day

K = 0.22 ft/day: 0.10 cfs — 45.79 gpm

LAD #1	cubic ft/day	CFS	gpm
Ramsey Creek	3439.4976	0.04	17.87
Poorman Creek	625.3632	0.01	3.25
LAD#2			
Ramsey Creek	2058.4872	0.02	10.69
Poorman Creek	1997.688	0.02	10.38
Libby Creek	694.848	0.01	3.61
			45.79

Max total flux (pre-LAD plus LAD application):

Maximum gradient to have ground water mounding to within ~10 bgs at LAD Areas is 0.122

K = 1 ft/day: 81480.14 cubic feet per day; 0.94 cfs; 423.24 gpm

K = 0.22 ft/day: 17925.6308 cubic feet per day; 0.21 cfs; 93.11 gpm

LAD#1	cubic ft/day	cfs	gpm
Ramsey Creek	6993.64512	0.08	36.33
Poorman Creek	1271.57184	0.01	6.61
LAD#2			42.93
Ramsey Creek	4185.59064	0.05	21.74
Poorman Creek	4061.9656	0.05	21.10
Libby Creek	1412.8576	0.02	7.34
			50.18
			93.11

Allowable percolation to ground water without flooding ground surface is:

K = 1 ft/day: 215.09 gpm

K = 0.22 ft/day: 47.32 gpm

	GPM	
LAD#1		
Ramsey Creek	18.46	
Poorman Creek	3.36	
	21.82	
LAD#2		
Ramsey Creek	11.05	
Poorman Creek	10.72	
Libby Creek	3.73	
	25.50	47.32

LAD Application Rates

Maximum application rate for 200 acre LAD area

ET during 6-mo growing season =	18	in/growing season, or	0.0082 ft/day
Precip during growing season =	13.24	in/growing season, or	0.0060 ft/day
Precip per year =	36	in/year	0.0060 ft/day

ET on 200 acres=	370.96	gpm
Precip on 200 acres=	272.86	gpm

	K= 1 ft/day	K = 0.22 ft/day
Alternative 2 maximum ground water flux rate=	145.37 gpm	31.98 gpm
Alts 3 and 4 maximum ground water flux rate=	215.09 gpm	47.32 gpm

		K = 1 ft/day	K = 0.22 ft/day
Maximum LAD application rate= (for 200 acres)	ET+ground water flux rate-precip=	**243.47 gpm for Alternative 2** **313.19 gpm for Alts 3 and 4**	**130.08 gpm for Alternative 2** **145.42 gpm for Alts 3 and 4**

Alternative 2	**Area (ac)**	**Percolation to ground water**	**Proportion of total perc to ground water**	**ET-PPT**	**Max Application Rate**	**LAD Total Max Application Rate**	
LAD#1		**gpm**		**gpm**	**gpm**	**gpm**	
Ramsey Creek	100	14.17	100%	49.05	63.22	63.22	LAD # 1
LAD#2							
Ramsey Creek	20	3.92	20%	9.81	13.73	66.86	LAD # 2
Libby Creek	30	4.85	30%	14.71	19.56		
Poorman Creek	50	9.04	50%	24.52	33.57		
	200					**130.08 total**	

Alternatives 3 & 4	**Area (ac)**	**Percolation to ground water**	**Proportion of total perc to ground water**	**ET-PPT**	**Max Application Rate**	**LAD Total Max Application Rate**	
LAD#1		**gpm**		**gpm**	**gpm**	**gpm**	
Ramsey Creek	162.5	18.46	90%	79.70	98.17	114.72	LAD #1
Poorman Creek	26.9	3.36	10%	13.19	16.55		
LAD#2							
Ramsey Creek	40.3	11.05	53%	19.77	30.82	83.13	LAD#2
Poorman Creek	62	10.72	34%	30.41	41.13		
Libby Creek	15.2	3.73	13%	7.46	11.19		
	306.9					**197.85 total**	

NOTES: Actual ET=12.71 inches is for average precipitation conditions, mountainous coniferous forest in NW Montana
Potential ET=26 inches, which is for unrestricted water availability (used by Geomatrix)
Actual ET=PET-actual soil moisture content

Calculation of 7Q10 low flows for Montanore site

7Q10 (cfs) = 0.0000728*A^(1.06)*P^(1. Reference: Hortness, 2006.

A=drainage area in square miles
P=precipitation in inches

Monitoring site	Drainage Area (sq miles)	Precipitation (inches)	Average 7Q10 (cfs)	Low range 7Q10 (cfs)	High range 7Q10 (cfs)
LB 300	7.4	63	2.22	1.04	4.73
LB 800	23.9	49.9	4.85	2.27	10.32
LB 1000	34.1	48	6.54	3.07	13.93
LB 1500	37	48	7.13	3.35	15.19
LB 2000	40.7	46	7.25	3.40	15.45
PM 1000	5.8	47.3	0.97	0.46	2.07
PM 1200	6.2	46	0.99	0.46	2.10
RA 400	5.9	56	1.38	0.65	2.94
RA 600	6.8	53.3	1.46	0.68	3.10

	Gpm
LB 300	996
LB 800	2,175
LB 1000	2,936
LB 1500	3,201
LB 2000	3,255
PM 1000	436
PM 1200	443
RA 400	620
RA 600	654

MINE DISCHARGE RATES

Rates limited by ground water horizontal K, so flow rates are same for construction, mining and post-mining at LAD areas
For natural ground water flow, use 35 gpm for under tailings impoundment, 31 gpm for LAD areas in Alt 2, 46 gpm for LAD areas Alts 3&4.

	Construction			Mining			Post-mining		
	Alt 2	Alt 3	Alt 4	Alt 2	Alt 3	Alt 4	Alt 2	Alt 3	Alt 4
Outflows									
@ LADs									
ET @ LADs									
Seepage to GW									
To Ramsey Creek									
RA 400	14	18.5	18.5	14	18.5	18.5	14	18.5	18.5
RA 600	4	11	11	4	11	11	4	11	11
To Poorman Creek									
PM 1000		3.4	3.4		3.4	3.4		3.4	3.4
PM 1200	9	10.7	10.7	9	10.7	10.7	9	10.7	10.7
To Libby Creek LB 800	5	3.7	3.7	5	3.7	3.7	5	3.7	3.7
Subtotal									
Percent Sources--LAD Areas									
Construction	all construction adit water								
Mining	25% mine water, 75% mining adit water								
Post-Mining	all post mining TI water								
Discharge from Treatment Plants									
Water to Libby Adit Treatment Plant (LB 300)	345	201	201	164	350	130	35	291	0
Water to Ramsey Treatment Plant (LB 800)	130	0	0	0	0	0	0	0	0

Construction Inflows			
From Libby Adit(s)	345#	300+	300+
From Ramsey Adits	195#		
Total Inflows	540*	300	300
Construction Discharge Management			
To LADs (average annual rate)	65	99	99
To Libby WTP	345	201	201
To Ramsey WTP	130	0	0
Total Discharge	540	300	300

Assumption and Sources:
*Table 3 1/07 MPDES Permit Application

#Table 3 1/07 MPDES Permit Application; 1/2 Ramsey Adits to Libby Adit, other 1/2 out Ramsey Adits
+Twice steady state modeled inflow of Libby Adit

Mining Discharges Total Average Annual Excess Water	229	449	229
Average annual discharge to LADs	65	99	99
To Libby WTP	164	350	130

Post-Mining Discharges Total Average Annual Excess Water	100	390	100
Average annual discharge to LADs	65	99	99
To Libby WTP	35	291	1

TREATMENT WATER QUALITY CALCULATIONS

Alternative 2

LAD applicaton area=	200	acres
LAD application rate=	130	gpm
Precipitation on 200 acres=	273	gpm
ET on 200 acres=	371	gpm
Net applied water=	32	gpm

		Mine Wastewater		Adit Wastewater During Construction		Adit Wastewater Post-Construction		Tailings Waste
	Treatment Rate	Mine wastewater concentration (mg/L)	Concentration of percolate to ground water	Construction adit wastewater concentration (mg/L)	Concentration of percolate to ground water	Post-construction adit water concentration (mg/L)	Concentration of percolate to ground water	Tailings impoundment post-mining water
TDS	0%	140	569	162	658	162	658	200
Ammonia	50%	10	20.31	10	20.31	<0.06	<0.12	7.3
Nitrate	50%	25	50.78	25	50.78	<0.21	<0.43	16.1
Antimony	50%	0.009	0.018	<0.003	<0.006	<0.003	<0.006	0.009
Arsenic	50%	<0.002	<0.004	<0.004	<0.008	<0.004	<0.008	<0.005
Cadmium	50%	<0.0002	<0.0004	<0.0003	<0.0006	<0.0003	<0.0006	<0.002
Chromium	50%	<0.001	<0.002	<0.006	<0.012	<0.006	<0.012	<0.001
Copper	90%	0.045	0.018	<0.004	<0.002	<0.004	<0.002	0.035
Iron	50%	0.03	0.06	<0.05	<0.10	<0.05	<0.10	<0.04
Lead	90%	<0.002	<0.001	<0.004	<0.002	<0.004	<0.002	<0.013
Manganese	10%	0.044	0.161	<0.01	<0.04	<0.01	<0.04	0.54
Mercury	50%	<0.0002	<0.0004	<0.0002	<0.0004	<0.0002	<0.0004	<0.001
Silver	50%	<0.003	<0.006	<0.0007	<0.0014	<0.0007	<0.0014	<0.004
Zinc	10%	0.01	0.04	<0.03	<0.11	<0.03	<0.11	<0.02

Alternatives 3 and 4

LAD applicaton area=	307	acres
LAD application rate=	198	gpm
Precipitation on 307 acres=	419	gpm
ET on 307 acres=	569	gpm
Net applied water=	48	gpm

	Treatment Rate	Mine wastewater concentration after 90% nitrate removal (mg/L)	Concentration of percolate to ground water	Construction adit wastewater concentration after 90% nitrate removal	Concentration of percolate to ground water	Post-construction adit water concentration (mg/L)	Concentration of percolate to ground water	Tailings impoundment post-mining water after 90% nitrate removal
TDS	0%	140	583	162	674	162	674	200
Ammonia	50%	10	20.81	10	20.81	<0.06	<0.12	7.3
Nitrate	50%	2.5	5.2	2.5	5.2	<0.21	<0.44	1.6
Antimony	50%	0.009	0.019	<0.003	<0.006	<0.003	<0.006	0.009
Arsenic	50%	<0.002	<0.004	<0.004	<0.008	<0.004	<0.008	<0.005
Cadmium	50%	<0.0002	<0.0004	<0.0003	<0.0006	<0.0003	<0.0006	<0.002
Chromium	50%	<0.001	<0.002	<0.006	<0.012	<0.006	<0.012	<0.001
Copper	90%	0.045	0.019	<0.004	<0.002	<0.004	<0.002	0.035
Iron	50%	0.03	0.06	<0.05	<0.10	<0.05	<0.10	<0.04
Lead	90%	<0.002	<0.001	<0.004	<0.002	<0.004	<0.002	<0.013
Manganese	10%	0.044	0.165	<0.01	<0.04	<0.01	<0.04	0.54
Mercury	50%	<0.0002	<0.0004	<0.0002	<0.0004	<0.0002	<0.0004	<0.001
Silver	50%	<0.003	<0.006	<0.0007	<0.0010	<0.0007	<0.0015	<0.004
Zinc	10%	0.01	0.04	<0.03	<0.11	<0.03	<0.11	<0.02

water Post-Operations
Concentration of percolate to ground water
813
14.8
32.7
0.018
<0.010
<0.004
<0.002
0.014
<0.08
<0.005
1.97
<0.002
<0.008
<0.07
Concentration of percolate to ground water
832
15.2
3.4
0.019
<0.010
<0.004
<0.002
0.015
<0.08
<0.005
2.02
<0.002
<0.008
<0.07

RAMSEY CREEK at RA 400
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	658	14	658	0	569	0	100	0	813	0	<27	634		100
Ammonia	<0.05	620	20.31	14	<0.12	0	20.31	0	0.05	0	14.8	0	<0.50	634	True	TIN=1
Nitrate	<0.06	620	50.78	14	<0.43	0	50.78	0	0.03	0	32.7	0	<1.18	634	True	TIN=1
Antimony	<0.003	620	<0.006	14	<0.006	0	0.018	0	0.003	0	<0.018	0	<0.003	634		0.0056
Copper	<0.001	620	<0.002	14	<0.002	0	<0.018	0	0.002	0	0.014	0	<0.001	634		0.003
Iron	<0.05	620	<0.10	14	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	634		0.1
Manganese	<0.02	620	<0.04	14	<0.04	0	0.161	0	0.005	0	1.97	0	<0.02	634		0.05
Zinc	<0.02	620	<0.11	14	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	634		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	674	18.5	674	0	583	0	100	0	832	0	<32	638.5		100
Ammonia	<0.05	620	20.81	18.5	<0.12	0	20.81	0	0.05	0	15.2	0	<0.65	638.5		TIN=1
Nitrate	<0.06	620	5.2	18.5	<0.44	0	5.2	0	0.03	0	3.4	0	<0.21	638.5		TIN=1
Antimony	<0.003	620	<0.006	18.5	<0.006	0	0.019	0	0.003	0	<0.019	0	<0.003	638.5		0.0056
Copper	<0.001	620	<0.002	18.5	<0.002	0	<0.019	0	0.002	0	0.015	0	<0.001	638.5		0.003
Iron	<0.05	620	<0.10	18.5	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	638.5		0.1
Manganese	<0.02	620	<0.04	18.5	<0.04	0	0.165	0	0.005	0	2.02	0	<0.02	638.5		0.05
Zinc	<0.02	620	<0.11	18.5	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	638.5		0.025

RAMSEY CREEK at RA 400
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	658	0	658	9.25	569	4.75	100	0	813	0	<27	634		100
Ammonia	<0.05	620	20.31	0	<0.12	9.25	20.31	4.75	0.05	0	14.8	0	<0.20	634		TIN=1
Nitrate	<0.06	620	50.78	0	<0.43	9.25	50.78	4.75	0.03	0	32.7	0	<0.45	634		TIN=1
Antimony	<0.003	620	<0.006	0	<0.006	9.25	0.018	4.75	0.003	0	<0.018	0	<0.003	634		0.0056
Copper	<0.001	620	<0.002	0	<0.002	9.25	<0.018	4.75	0.002	0	0.014	0	<0.001	634		0.003
Iron	<0.05	620	<0.10	0	<0.10	9.25	0.06	4.75	0.01	0	<0.08	0	<0.05	634		0.1
Manganese	<0.02	620	<0.04	0	<0.04	9.25	0.161	4.75	0.005	0	1.97	0	<0.02	634		0.05
Zinc	<0.02	620	<0.11	0	<0.11	9.25	<0.04	4.75	0.01	0	<0.07	0	<0.02	634		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	674	0	674	12.25	583	6.25	100	0	832	0	<31	638.5		100
Ammonia	<0.05	620	20.81	0	<0.12	12.25	20.81	6.25	0.05	0	15.2	0	<0.25	638.5		TIN=1
Nitrate	<0.06	620	5.2	0	<0.44	12.25	5.2	6.25	0.03	0	3.4	0	<0.12	638.5		TIN=1
Antimony	<0.003	620	<0.006	0	<0.006	12.25	0.019	6.25	0.003	0	<0.019	0	<0.003	638.5		0.0056
Copper	<0.001	620	<0.002	0	<0.002	12.25	<0.019	6.25	0.002	0	0.015	0	<0.001	638.5		0.003
Iron	<0.05	620	<0.10	0	<0.10	12.25	0.06	6.25	0.01	0	<0.08	0	<0.05	638.5		0.1
Manganese	<0.02	620	<0.04	0	<0.04	12.25	0.165	6.25	0.005	0	2.02	0	<0.02	638.5		0.05
Zinc	<0.02	620	<0.11	0	<0.11	12.25	<0.04	6.25	0.01	0	<0.07	0	<0.02	638.5		0.025

RAMSEY CREEK at RA 400
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	658	0	658	0	569	0	100	0	813	14	<31	634.0		100
Ammonia	<0.05	620	20.31	0	<0.12	0	20.31	0	0.05	0	14.8	14	<0.38	634.0	True	TIN=1
Nitrate	<0.06	620	50.78	0	<0.43	0	50.78	0	0.03	0	32.7	14	<0.78	634.0	True	TIN=1
Antimony	<0.003	620	<0.006	0	<0.006	0	0.018	0	0.003	0	<0.018	14	<0.003	634.0		0.0056
Copper	<0.001	620	<0.002	0	<0.002	0	<0.018	0	0.002	0	0.014	14	<0.001	634.0		0.003
Iron	<0.05	620	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	14	<0.05	634.0		0.1
Manganese	<0.02	620	<0.04	0	<0.04	0	0.161	0	0.005	0	1.97	14	<0.06	634.0	True	0.05
Zinc	<0.02	620	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	14	<0.02	634.0		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	620	674	0	674	0	583	0	100	0	832	18.5	<37	638.5		100
Ammonia	<0.05	620	20.81	0	<0.12	0	20.81	0	0.05	0	15.2	18.5	<0.49	638.5		TIN=1
Nitrate	<0.06	620	5.2	0	<0.44	0	5.2	0	0.03	0	3.4	18.5	<0.16	638.5		TIN=1
Antimony	<0.003	620	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	18.5	<0.003	638.5		0.0056
Copper	<0.001	620	<0.002	0	<0.002	0	<0.019	0	0.002	0	0.015	18.5	<0.001	638.5		0.003
Iron	<0.05	620	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	18.5	<0.05	638.5		0.1
Manganese	<0.02	620	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	18.5	<0.08	638.5	True	0.05
Zinc	<0.02	620	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	18.5	<0.02	638.5		0.025

RAMSEY CREEK at RA 600
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	658	18	658	0	569	0	100	0	813	0	<30	672		100
Ammonia	<0.05	654	20.31	18	<0.12	0	20.31	0	0.05	0	14.8	0	<0.59	672	True	TIN=1
Nitrate	<0.06	654	50.78	18	<0.43	0	50.78	0	0.03	0	32.7	0	<1.42	672	True	TIN=1
Antimony	<0.003	654	<0.006	18	<0.006	0	0.018	0	0.003	0	<0.018	0	<0.003	672		0.0056
Copper	<0.001	654	<0.002	18	<0.002	0	<0.018	0	0.002	0	0.014	0	<0.001	672		0.003
Iron	<0.05	654	<0.10	18	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	672		0.1
Manganese	<0.02	654	<0.04	18	<0.04	0	0.161	0	0.005	0	1.97	0	<0.02	672		0.05
Zinc	<0.02	654	<0.11	18	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	672		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	674	29.5	674	0	583	0	100	0	832	0	<42	683.5		100
Ammonia	<0.05	654	20.81	29.5	<0.12	0	20.81	0	0.05	0	15.2	0	<0.95	683.5	True	TIN=1
Nitrate	<0.06	654	5.2	29.5	<0.44	0	5.2	0	0.03	0	3.4	0	<0.28	683.5	True	TIN=1
Antimony	<0.003	654	<0.006	29.5	<0.006	0	0.019	0	0.003	0	<0.019	0	<0.003	683.5		0.0056
Copper	<0.001	654	<0.002	29.5	<0.002	0	<0.019	0	0.002	0	0.015	0	<0.001	683.5		0.003
Iron	<0.05	654	<0.10	29.5	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	683.5		0.1
Manganese	<0.02	654	<0.04	29.5	<0.04	0	0.165	0	0.005	0	2.02	0	<0.02	683.5		0.05
Zinc	<0.02	654	<0.11	29.5	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	683.5		0.025

RAMSEY CREEK at RA 600
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	658	0	658	6	569	12	100	0	813	0	<29	672		100
Ammonia	<0.05	654	20.31	0	<0.12	6	20.31	12	0.05	0	14.8	0	<0.41	672	True	TIN=1
Nitrate	<0.06	654	50.78	0	<0.43	6	50.78	12	0.03	0	32.7	0	<0.97	672	True	TIN=1
Antimony	<0.003	654	<0.006	0	<0.006	6	0.018	12	0.003	0	<0.018	0	<0.003	672		0.0056
Copper	<0.001	654	<0.002	0	<0.002	6	<0.018	12	0.002	0	0.014	0	<0.001	672		0.003
Iron	<0.05	654	<0.10	0	<0.10	6	0.06	12	0.01	0	<0.08	0	<0.05	672		0.1
Manganese	<0.02	654	<0.04	0	<0.04	6	0.161	12	0.005	0	1.97	0	<0.02	672		0.05
Zinc	<0.02	654	<0.11	0	<0.11	6	<0.04	12	0.01	0	<0.07	0	<0.02	672		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	674	0	674	19.5	583	10	100	0	832	0	<40	683.5		100
Ammonia	<0.05	654	20.81	0	<0.12	19.5	20.81	10	0.05	0	15.2	0	<0.36	683.5		TIN=1
Nitrate	<0.06	654	5.2	0	<0.44	19.5	5.2	10	0.03	0	3.4	0	<0.15	683.5		TIN=1
Antimony	<0.003	654	<0.006	0	<0.006	19.5	0.019	10	0.003	0	<0.019	0	<0.003	683.5		0.0056
Copper	<0.001	654	<0.002	0	<0.002	19.5	<0.019	10	0.002	0	0.015	0	<0.001	683.5		0.003
Iron	<0.05	654	<0.10	0	<0.10	19.5	0.06	10	0.01	0	<0.08	0	<0.05	683.5		0.1
Manganese	<0.02	654	<0.04	0	<0.04	19.5	0.165	10	0.005	0	2.02	0	<0.02	683.5		0.05
Zinc	<0.02	654	<0.11	0	<0.11	19.5	<0.04	10	0.01	0	<0.07	0	<0.02	683.5		0.025

RAMSEY CREEK at RA 600
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	658	0	658	0	569	0	100	0	813	18	<34	672		100
Ammonia	<0.05	654	20.31	0	<0.12	0	20.31	0	0.05	0	14.8	18	<0.45	672	True	TIN=1
Nitrate	<0.06	654	50.78	0	<0.43	0	50.78	0	0.03	0	32.7	18	<0.93	672	True	TIN=1
Antimony	<0.003	654	<0.006	0	<0.006	0	0.018	0	0.003	0	<0.018	18	<0.003	672		0.0056
Copper	<0.001	654	<0.002	0	<0.002	0	<0.018	0	0.002	0	0.014	18	<0.001	672		0.003
Iron	<0.05	654	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	18	<0.05	672		0.1
Manganese	<0.02	654	<0.04	0	<0.04	0	0.161	0	0.005	0	1.97	18	<0.07	672	True	0.05
Zinc	<0.02	654	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	18	<0.02	672		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<13	654	674	0	674	0	583	0	100	0	832	29.5	<48	683.5		100
Ammonia	<0.05	654	20.81	0	<0.12	0	20.81	0	0.05	0	15.2	29.5	<0.70	683.5		TIN=1
Nitrate	<0.06	654	5.2	0	<0.44	0	5.2	0	0.03	0	3.4	29.5	<0.20	683.5		TIN=1
Antimony	<0.003	654	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	29.5	<0.004	683.5		0.0056
Copper	<0.001	654	<0.002	0	<0.002	0	<0.019	0	0.002	0	0.015	29.5	<0.002	683.5		0.003
Iron	<0.05	654	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	29.5	<0.05	683.5		0.1
Manganese	<0.02	654	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	29.5	<0.11	683.5	True	0.05
Zinc	<0.02	654	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	29.5	<0.02	683.5		0.025

POORMAN CREEK at PM 1000
Construction

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	436	674	3.4	674	0	583	0	100	0	832	0	<25	439.4		100
Ammonia	<0.05	436	20.81	3.4	<0.12	0	20.81	0	0.05	0	15.2	0	<0.21	439.4		TIN=1
Nitrate	<0.05	436	5.2	3.4	<0.44	0	5.2	0	0.03	0	3.4	0	<0.09	439.4		TIN=1
Antimony	<0.003	436	<0.006	3.4	<0.006	0	0.019	0	0.003	0	<0.019	0	<0.003	439.4		0.0056
Copper	<0.001	436	<0.002	3.4	<0.002	0	<0.019	0	0.002	0	0.015	0	<0.001	439.4		0.003
Iron	<0.05	436	<0.10	3.4	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	439.4		0.1
Manganese	<0.02	436	<0.04	3.4	<0.04	0	0.165	0	0.005	0	2.02	0	<0.02	439.4		0.05
Zinc	<0.02	436	<0.11	3.4	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	439.4		0.025

POORMAN CREEK at PM 1000
Mining

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	436	674	0	674	1.15	583	2.25	100	0	832	0	<25	439.4		100
Ammonia	<0.05	436	20.81	0	<0.12	1.15	20.81	2.25	0.05	0	15.2	0	<0.16	439.4		TIN=1
Nitrate	<0.05	436	5.2	0	<0.44	1.15	5.2	2.25	0.03	0	3.4	0	<0.08	439.4		TIN=1
Antimony	<0.003	436	<0.006	0	<0.006	1.15	0.019	2.25	0.003	0	<0.019	0	<0.003	439.4		0.0056
Copper	<0.001	436	<0.002	0	<0.002	1.15	<0.019	2.25	0.002	0	0.015	0	<0.001	439.4		0.003
Iron	<0.05	436	<0.10	0	<0.10	1.15	0.06	2.25	0.01	0	<0.08	0	<0.05	439.4		0.1
Manganese	<0.02	436	<0.04	0	<0.04	1.15	0.165	2.25	0.005	0	2.02	0	<0.02	439.4		0.05
Zinc	<0.02	436	<0.11	0	<0.11	1.15	<0.04	2.25	0.01	0	<0.07	0	<0.02	439.4		0.025

POORMAN CREEK at PM 1000
Postmining

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	436	674	0	674	0	583	0	100	0	832	3.4	<26	439.4		100
Ammonia	<0.05	436	20.81	0	<0.12	0	20.81	0	0.05	0	15.2	3.4	<0.17	439.4		TIN=1
Nitrate	<0.05	436	5.2	0	<0.44	0	5.2	0	0.03	0	3.4	3.4	<0.08	439.4		TIN=1
Antimony	<0.003	436	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	3.4	<0.003	439.4		0.0056
Copper	<0.001	436	<0.002	0	<0.002	0	<0.019	0	0.002	0	0.015	3.4	<0.001	439.4		0.003
Iron	<0.05	436	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	3.4	<0.05	439.4		0.1
Manganese	<0.02	436	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	3.4	<0.04	439.4		0.05
Zinc	<0.02	436	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	3.4	<0.02	439.4		0.025

POORMAN CREEK at PM 1200

Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	658	9	658	0	569	0	100	0	813	0	<33	452		100
Ammonia	<0.05	443	20.31	9	<0.12	0	20.31	0	0.05	0	14.8	0	<0.45	452	True	TIN=1
Nitrate	<0.05	443	50.78	9	<0.43	0	50.78	0	0.03	0	32.7	0	<1.06	452	True	TIN=1
Antimony	<0.003	443	<0.006	9	<0.006	0	0.018	0	0.003	0	<0.018	0	<0.003	452		0.0056
Copper	<0.001	443	<0.002	9	<0.002	0	<0.018	0	0.002	0	0.014	0	<0.001	452		0.003
Iron	<0.05	443	<0.10	9	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	452		0.1
Manganese	<0.02	443	<0.04	9	<0.04	0	0.161	0	0.005	0	1.97	0	<0.02	452		0.05
Zinc	<0.02	443	<0.11	9	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	452		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	674	14.1	674	0	583	0	100	0	832	0	<40	457.1		100
Ammonia	<0.05	443	20.81	14.1	<0.12	0	20.81	0	0.05	0	15.2	0	<0.69	457.1		TIN=1
Nitrate	<0.05	443	5.2	14.1	<0.44	0	5.2	0	0.03	0	3.4	0	<0.21	457.1		TIN=1
Antimony	<0.003	443	<0.006	14.1	<0.006	0	0.019	0	0.003	0	<0.019	0	<0.003	457.1		0.0056
Copper	<0.001	443	<0.002	14.1	<0.002	0	<0.019	0	0.002	0	0.015	0	<0.001	457.1		0.003
Iron	<0.05	443	<0.10	14.1	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	457.1		0.1
Manganese	<0.02	443	<0.04	14.1	<0.04	0	0.165	0	0.005	0	2.02	0	<0.02	457.1		0.05
Zinc	<0.02	443	<0.11	14.1	<0.11	0	<0.04	0	0.01	0	<0.07	0	<0.02	457.1		0.025

POORMAN CREEK at PM 1200
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	658	0	658	3	569	6	100		813		<32	452.0		100
Ammonia	<0.05	443	20.31	0	<0.12	3	20.31	6	0.05	0	14.8	0	<0.32	452.0	True	TIN=1
Nitrate	<0.05	443	50.78	0	<0.43	3	50.78	6	0.03	0	32.7	0	<0.73	452.0	True	TIN=1
Antimony	<0.003	443	<0.006	0	<0.006	3	0.018	6	0.003	0	<0.018	0	<0.003	452.0		0.0056
Copper	<0.001	443	<0.002	0	<0.002	3	<0.018	6	0.002	0	0.014	0	<0.001	452.0		0.003
Iron	<0.05	443	<0.10	0	<0.10	3	0.06	6	0.01	0	<0.08	0	<0.05	452.0		0.1
Manganese	<0.02	443	<0.04	0	<0.04	3	0.161	6	0.005	0	1.97	0	<0.02	452.0		0.05
Zinc	<0.02	443	<0.11	0	<0.11	3	<0.04	6	0.01	0	<0.07	0	<0.02	452.0		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	674	0	674	4.8	583	9.3	100		832		<38	457.1		100
Ammonia	<0.05	443	20.81	0	<0.12	4.8	20.81	9.3	0.05	0	15.2	0	<0.47	457.1		TIN=1
Nitrate	<0.05	443	5.2	0	<0.44	4.8	5.2	9.3	0.03	0	3.4	0	<0.16	457.1		TIN=1
Antimony	<0.003	443	<0.006	0	<0.006	4.8	0.019	9.3	0.003	0	<0.019	0	<0.003	457.1		0.0056
Copper	<0.001	443	<0.002	0	<0.002	4.8	<0.019	9.3	0.002	0	0.015	0	<0.001	457.1		0.003
Iron	<0.05	443	<0.10	0	<0.10	4.8	0.06	9.3	0.01	0	<0.08	0	<0.05	457.1		0.1
Manganese	<0.02	443	<0.04	0	<0.04	4.8	0.165	9.3	0.005	0	2.02	0	<0.02	457.1		0.05
Zinc	<0.02	443	<0.11	0	<0.11	4.8	<0.04	9.3	0.01	0	<0.07	0	<0.02	457.1		0.025

POORMAN CREEK at PM 1200
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	658	0	658	0	569	0	100	0	813	9	<36	452		100
Ammonia	<0.05	443	20.31	0	<0.12	0	20.31	0	0.05	0	14.8	9	<0.34	452	True	TIN=1
Nitrate	<0.05	443	50.78	0	<0.43	0	50.78	0	0.03	0	32.7	9	<0.70	452	True	TIN=1
Antimony	<0.003	443	<0.006	0	<0.006	0	0.018	0	0.003	0	<0.018	9	<0.003	452		0.0056
Copper	<0.001	443	<0.002	0	<0.002	0	<0.018	0	0.002	0	0.014	9	<0.001	452		0.003
Iron	<0.05	443	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	9	<0.05	452		0.1
Manganese	<0.02	443	<0.04	0	<0.04	0	0.161	0	0.005	0	1.97	9	<0.06	452	True	0.05
Zinc	<0.02	443	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	9	<0.02	452		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<20	443	674	0	674	0	583	0	100	0	832	14.1	<45	457.1		100
Ammonia	<0.05	443	20.81	0	<0.12	0	20.81	0	0.05	0	15.2	14.1	<0.52	457.1		TIN=1
Nitrate	<0.05	443	5.2	0	<0.44	0	5.2	0	0.03	0	3.4	14.1	<0.15	457.1		TIN=1
Antimony	<0.003	443	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	14.1	<0.003	457.1		0.0056
Copper	<0.001	443	<0.002	0	<0.002	0	<0.019	0	0.002	0	0.015	14.1	<0.001	457.1		0.003
Iron	<0.05	443	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	14.1	<0.05	457.1		0.1
Manganese	<0.02	443	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	14.1	<0.08	457.1	True	0.05
Zinc	<0.02	443	<0.11	0	<0.11	0	<0.04	0	0.01	0	<0.07	14.1	<0.02	457.1		0.025

LIBBY CREEK at LB 300
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	658	0	658	0	569	0	100	345	813	0	<39	1341		100
Ammonia	<0.05	996	20.31	0	<0.12	0	20.31	0	0.05	345	14.8	0	<0.05	1341		TIN=1
Nitrate	<0.12	996	50.78	0	<0.43	0	50.78	0	0.03	345	32.7	0	<0.10	1341		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.018	0	0.003	345	<0.018	0	<0.003	1341		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	<0.018	0	0.002	345	0.014	0	<0.001	1341		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	345	<0.08	0	<0.04	1341		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.161	0	0.005	345	1.97	0	<0.02	1341		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	<0.04	0	0.01	345	<0.07	0	<0.02	1341		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	674	0	674	0	583	0	100	201	832	0	<32	1197		100
Ammonia	<0.05	996	20.81	0	<0.12	0	20.81	0	0.05	201	15.2	0	<0.05	1197		TIN=1
Nitrate	<0.12	996	5.2	0	<0.44	0	5.2	0	0.03	201	3.4	0	<0.10	1197		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.019	0	0.003	201	<0.019	0	<0.003	1197		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	<0.019	0	0.002	201	0.015	0	<0.001	1197		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	201	<0.08	0	<0.04	1197		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.165	0	0.005	201	2.02	0	<0.02	1197		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	<0.04	0	0.01	201	<0.07	0	<0.02	1197		0.025

LIBBY CREEK at LB 300
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	658	0	658	0	569	0	100	164	813	0	<30	1160		100
Ammonia	<0.05	996	20.31	0	<0.12	0	20.31	0	0.05	164	14.8	0	<0.05	1160		TIN=1
Nitrate	<0.12	996	50.78	0	<0.43	0	50.78	0	0.03	164	32.7	0	<0.11	1160		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.018	0	0.003	164	<0.018	0	<0.003	1160		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	<0.018	0	0.002	164	0.014	0	<0.001	1160		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	164	<0.08	0	<0.04	1160		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.161	0	0.005	164	1.97	0	<0.02	1160		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	<0.04	0	0.01	164	<0.07	0	<0.02	1160		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	674	0	674	0.00	583	0	100	350	832	0	<39	1346		100
Ammonia	<0.05	996	20.81	0	<0.12	0.00	20.81	0	0.05	350	15.2	0	<0.05	1346		TIN=1
Nitrate	<0.12	996	5.2	0	<0.44	0.00	5.2	0	0.03	350	3.4	0	<0.10	1346		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0.00	0.019	0	0.003	350	<0.019	0	<0.003	1346		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0.00	<0.019	0	0.002	350	0.015	0	<0.001	1346		0.003
Iron	<0.05	996	<0.10	0	<0.10	0.00	0.06	0	0.01	350	<0.08	0	<0.04	1346		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0.00	0.165	0	0.005	350	2.02	0	<0.02	1346		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0.00	<0.04	0	0.01	350	<0.07	0	<0.02	1346		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	674	0	674	0.00	583	0.00	100	130	832	0	<27	1126		100
Ammonia	<0.05	996	21	0	<0.12	0.00	20.81	0.00	0.05	130	15.2	0	<0.05	1126		TIN=1
Nitrate	<0.12	996	5	0	<0.44	0.00	5.2	0.00	0.03	130	3.4	0	<0.11	1126		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0.00	0.019	0.00	0.003	130	<0.019	0	<0.003	1126		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0.00	0.019	0.00	0.002	130	0.015	0	<0.001	1126		0.003
Iron	<0.05	996	<0.10	0	<0.10	0.00	0.06	0.00	0.01	130	<0.08	0	<0.05	1126		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0.00	0.165	0.00	0.005	130	2.02	0	<0.02	1126		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0.00	0.04	0.00	0.01	130	<0.07	0	<0.02	1126		0.025

LIBBY CREEK at LB 300
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	658	0	658	0	569	0	100	35	813	0	<21	1031		100
Ammonia	<0.05	996	20.31	0	<0.12	0	20.31	0	0.05	35	14.8	0	<0.05	1031		TIN=1
Nitrate	<0.12	996	50.78	0	<0.43	0	50.78	0	0.03	35	32.7	0	<0.12	1031		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.018	0	0.003	35	<0.018	0	<0.003	1031		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	<0.018	0	0.002	35	0.014	0	<0.001	1031		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	35	<0.08	0	<0.05	1031		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.161	0	0.005	35	1.97	0	<0.02	1031		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	<0.04	0	0.01	35	<0.07	0	<0.02	1031		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	674	0	674	0	583	0	100	291	832	0	<37	1287		100
Ammonia	<0.05	996	20.81	0	<0.12	0	20.81	0	0.05	291	15.2	0	<0.05	1287		TIN=1
Nitrate	<0.12	996	5.2	0	<0.44	0	5.2	0	0.03	291	3.4	0	<0.10	1287		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.019	0	0.003	291	<0.019	0	<0.003	1287		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	<0.019	0	0.002	291	0.015	0	<0.001	1287		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	291	<0.08	0	<0.04	1287		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.165	0	0.005	291	2.02	0	<0.02	1287		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	<0.04	0	0.01	291	<0.07	0	<0.02	1287		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<18	996	674	0	674	0	583	0	100	0	832	0	<18	996		100
Ammonia	<0.05	996	21	0	<0.12	0	20.81	0	0.05	0	15.2	0	<0.05	996		TIN=1
Nitrate	<0.12	996	5	0	<0.44	0	5.2	0	0.03	0	3.4	0	<0.12	996		TIN=1
Antimony	<0.003	996	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	0	<0.003	996		0.0056
Copper	<0.001	996	<0.002	0	<0.002	0	0.019	0	0.002	0	0.015	0	<0.001	996		0.003
Iron	<0.05	996	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	0	<0.05	996		0.1
Manganese	<0.02	996	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	0	<0.02	996		0.05
Zinc	<0.02	996	<0.11	0	<0.11	0	0.04	0	0.01	0	<0.07	0	<0.02	996		0.025

LIBBY CREEK at LB 800
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	658	23	658	0	569	0	100	475	813	0	38	2673		100
Ammonia	<0.05	2175	20.31	23	<0.12	0	20.31	0	0.05	475	14.8	0	<0.22	2673		TIN=1
Nitrate	0.04	2175	50.78	23	<0.43	0	50.78	0	0.03	475	32.7	0	0.47	2673		TIN=1
Antimony	<0.003	2175	<0.006	23	<0.006	0	0.018	0	0.003	475	<0.018	0	<0.003	2673		0.0056
Copper	<0.001	2175	<0.002	23	<0.002	0	<0.018	0	0.002	475	0.014	0	<0.001	2673		0.003
Iron	<0.05	2175	<0.10	23	<0.10	0	0.06	0	0.01	475	<0.08	0	<0.04	2673		0.1
Manganese	<0.02	2175	<0.04	23	<0.04	0	0.161	0	0.005	475	1.97	0	<0.02	2673		0.05
Zinc	<0.02	2175	<0.11	23	<0.11	0	<0.04	0	0.01	475	<0.07	0	<0.02	2673		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	674	33.2	674	0	583	0	100	201	832	0	34	2409		100
Ammonia	<0.05	2175	20.81	33.2	<0.12	0	20.81	0	0.05	201	15.2	0	<0.34	2409		TIN=1
Nitrate	0.04	2175	5.2	33.2	<0.44	0	5.2	0	0.03	201	3.4	0	0.11	2409		TIN=1
Antimony	<0.003	2175	<0.006	33.2	<0.006	0	0.019	0	0.003	201	<0.019	0	<0.003	2409		0.0056
Copper	<0.001	2175	<0.002	33.2	<0.002	0	<0.019	0	0.002	201	0.015	0	<0.001	2409		0.003
Iron	<0.05	2175	<0.10	33.2	<0.10	0	0.06	0	0.01	201	<0.08	0	<0.05	2409		0.1
Manganese	<0.02	2175	<0.04	33.2	<0.04	0	0.165	0	0.005	201	2.02	0	<0.02	2409		0.05
Zinc	<0.02	2175	<0.11	33.2	<0.11	0	<0.04	0	0.01	201	<0.07	0	<0.02	2409		0.025

LIBBY CREEK at LB 800
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	658	0	658	7.8	569	15.2	100	164	813	0	29	2362		100
Ammonia	<0.05	2175	20.31	0	<0.12	7.8	20.31	15.2	0.05	164	14.8	0	<0.18	2362		TIN=1
Nitrate	0.04	2175	50.78	0	<0.43	7.8	50.78	15.2	0.03	164	32.7	0	<0.37	2362		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	7.8	0.018	15.2	0.003	164	<0.018	0	<0.003	2362		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	7.8	<0.018	15.2	0.002	164	0.014	0	<0.001	2362		0.003
Iron	<0.05	2175	<0.10	0	<0.10	7.8	0.06	15.2	0.01	164	<0.08	0	<0.05	2362		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	7.8	0.161	15.2	0.005	164	1.97	0	<0.02	2362		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	7.8	<0.04	15.2	0.01	164	<0.07	0	<0.02	2362		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	674	0	674	11.1	583	22.1	100	350	832	0	37	2558		100
Ammonia	<0.05	2175	20.81	0	<0.12	11.1	20.81	22.1	0.05	350	15.2	0	<0.23	2558		TIN=1
Nitrate	0.04	2175	5.2	0	<0.44	11.1	5.2	22.1	0.03	350	3.4	0	<0.08	2558		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	11.1	0.019	22.1	0.003	350	<0.019	0	<0.003	2558		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	11.1	<0.019	22.1	0.002	350	0.015	0	<0.001	2558		0.003
Iron	<0.05	2175	<0.10	0	<0.10	11.1	0.06	22.1	0.01	350	<0.08	0	<0.04	2558		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	11.1	0.165	22.1	0.005	350	2.02	0	<0.02	2558		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	11.1	<0.04	22.1	0.01	350	<0.07	0	<0.02	2558		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	674	0	674	11.1	583	11.1	100	130	832	0	28	2327		100
Ammonia	<0.05	2175	21	0	<0.12	11.1	20.81	11.1	0.05	130	15.2	0	<0.15	2327		TIN=1
Nitrate	0.04	2175	5	0	<0.44	11.1	5.2	11.1	0.03	130	3.4	0	<0.07	2327		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	11.1	0.019	11.1	0.003	130	<0.019	0	<0.003	2327		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	11.1	0.019	11.1	0.002	130	0.015	0	<0.001	2327		0.003
Iron	<0.05	2175	<0.10	0	<0.10	11.1	0.06	11.1	0.01	130	<0.08	0	<0.05	2327		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	11.1	0.165	11.1	0.005	130	2.02	0	<0.02	2327		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	11.1	0.04	11.1	0.01	130	<0.07	0	<0.02	2327		0.025

LIBBY CREEK at LB 800
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	658	0	658	0	569	0	100	35	813	23	27	2233		100
Ammonia	<0.05	2175	20.31	0	<0.12	0	20.31	0	0.05	35	14.8	23	<0.20	2233		TIN=1
Nitrate	0.04	2175	50.78	0	<0.43	0	50.78	0	0.03	35	32.7	23	0.38	2233		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	0	0.018	0	0.003	35	<0.018	23	<0.003	2233		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	0	<0.018	0	0.002	35	0.014	23	<0.001	2233		0.003
Iron	<0.05	2175	<0.10	0	<0.10	0	0.06	0	0.01	35	<0.08	23	<0.05	2233		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	0	0.161	0	0.005	35	1.97	23	<0.04	2233		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	0	<0.04	0	0.01	35	<0.07	23	<0.02	2233		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	674	0	674	0	583	0	100	291	832	33.2	38	2499		100
Ammonia	<0.05	2175	20.81	0	<0.12	0	20.81	0	0.05	291	15.2	33.2	<0.25	2499		TIN=1
Nitrate	0.04	2175	5.2	0	<0.44	0	5.2	0	0.03	291	3.4	33.2	0.08	2499		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	0	0.019	0	0.003	291	<0.019	33.2	<0.003	2499		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	0	<0.019	0	0.002	291	0.015	33.2	<0.001	2499		0.003
Iron	<0.05	2175	<0.10	0	<0.10	0	0.06	0	0.01	291	<0.08	33.2	<0.05	2499		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	0	0.165	0	0.005	291	2.02	33.2	<0.04	2499		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	0	<0.04	0	0.01	291	<0.07	33.2	<0.02	2499		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	18	2175	674	0	674	0	583	0	100	0	832	33.2	30	2208		100
Ammonia	<0.05	2175	21	0	<0.12	0	20.81	0	0.05	0	15.2	33.2	<0.28	2208		TIN=1
Nitrate	0.04	2175	5	0	<0.44	0	5.2	0	0.03	0	3.4	33.2	0.09	2208		TIN=1
Antimony	<0.003	2175	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	33.2	<0.003	2208		0.0056
Copper	<0.001	2175	<0.002	0	<0.002	0	0.019	0	0.002	0	0.015	33.2	<0.001	2208		0.003
Iron	<0.05	2175	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	33.2	<0.05	2208		0.1
Manganese	<0.02	2175	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	33.2	<0.05	2208		0.05
Zinc	<0.02	2175	<0.11	0	<0.11	0	0.04	0	0.01	0	<0.07	33.2	<0.02	2208		0.025

LIBBY CREEK at LB 1000
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	658	32	658	0	569	0	100	475	813	0	<45	3443		100
Ammonia	<0.05	2936	20.31	32	<0.12	0	20.31	0	0.05	475	14.8	0	<0.24	3443		TIN=1
Nitrate	0.05	2936	50.78	32	<0.43	0	50.78	0	0.03	475	32.7	0	0.52	3443		TIN=1
Antimony	<0.004	2936	<0.006	32	<0.006	0	0.018	0	0.003	475	<0.018	0	<0.004	3443		0.0056
Copper	<0.001	2936	<0.002	32	<0.002	0	<0.018	0	0.002	475	0.014	0	<0.001	3443		0.003
Iron	<0.05	2936	<0.10	32	<0.10	0	0.06	0	0.01	475	<0.08	0	<0.04	3443		0.1
Manganese	<0.02	2936	<0.04	32	<0.04	0	0.161	0	0.005	475	1.97	0	<0.02	3443		0.05
Zinc	<0.02	2936	<0.11	32	<0.11	0	<0.04	0	0.01	475	<0.07	0	<0.02	3443		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	674	47.3	674	0	583	0	100	201	832	0	<44	3184		100
Ammonia	<0.05	2936	20.81	47.3	<0.12	0	20.81	0	0.05	201	15.2	0	<0.36	3184		TIN=1
Nitrate	0.05	2936	5.2	47.3	<0.44	0	5.2	0	0.03	201	3.4	0	0.13	3184		TIN=1
Antimony	<0.004	2936	<0.006	47.3	<0.006	0	0.019	0	0.003	201	<0.019	0	<0.004	3184		0.0056
Copper	<0.001	2936	<0.002	47.3	<0.002	0	<0.019	0	0.002	201	0.015	0	<0.001	3184		0.003
Iron	<0.05	2936	<0.10	47.3	<0.10	0	0.06	0	0.01	201	<0.08	0	<0.05	3184		0.1
Manganese	<0.02	2936	<0.04	47.3	<0.04	0	0.165	0	0.005	201	2.02	0	<0.02	3184		0.05
Zinc	<0.02	2936	<0.11	47.3	<0.11	0	<0.04	0	0.01	201	<0.07	0	<0.02	3184		0.025

LIBBY CREEK at LB 1000
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	658	0	658	10.9	569	21.1	100	164	813	0	<39	3132		100
Ammonia	<0.05	2936	20.31	0	<0.12	10.9	20.31	21.1	0.05	164	14.8	0	<0.19	3132		TIN=1
Nitrate	0.05	2936	50.78	0	<0.43	10.9	50.78	21.1	0.03	164	32.7	0	<0.39	3132		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	10.9	0.018	21.1	0.003	164	<0.018	0	<0.004	3132		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	10.9	<0.018	21.1	0.002	164	0.014	0	<0.001	3132		0.003
Iron	<0.05	2936	<0.10	0	<0.10	10.9	0.06	21.1	0.01	164	<0.08	0	<0.05	3132		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	10.9	0.161	21.1	0.005	164	1.97	0	<0.02	3132		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	10.9	<0.04	21.1	0.01	164	<0.07	0	<0.02	3132		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	674	0	674	16.1	583	31.2	100	350	832	0	<46	3333		100
Ammonia	<0.05	2936	20.81	0	<0.12	16.1	20.81	31.2	0.05	350	15.2	0	<0.24	3333		TIN=1
Nitrate	0.05	2936	5.2	0	<0.44	16.1	5.2	31.2	0.03	350	3.4	0	<0.10	3333		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	16.1	0.019	31.2	0.003	350	<0.019	0	<0.004	3333		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	16.1	<0.019	31.2	0.002	350	0.015	0	<0.001	3333		0.003
Iron	<0.05	2936	<0.10	0	<0.10	16.1	0.06	31.2	0.01	350	<0.08	0	<0.05	3333		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	16.1	0.165	31.2	0.005	350	2.02	0	<0.02	3333		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	16.1	<0.04	31.2	0.01	350	<0.07	0	<0.02	3333		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	674	0	674	16.1	583	31.2	100	130	832	0	<42	3113		100
Ammonia	<0.05	2936	21	0	<0.12	16.1	20.81	31.2	0.05	130	15.2	0	<0.26	3113		TIN=1
Nitrate	0.05	2936	5	0	<0.44	16.1	5.2	31.2	0.03	130	3.4	0	<0.10	3113		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	16.1	0.019	31.2	0.003	130	<0.019	0	<0.004	3113		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	16.1	0.019	31.2	0.002	130	0.015	0	<0.001	3113		0.003
Iron	<0.05	2936	<0.10	0	<0.10	16.1	0.06	31.2	0.01	130	<0.08	0	<0.05	3113		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	16.1	0.165	31.2	0.005	130	2.02	0	<0.02	3113		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	16.1	0.04	31.2	0.01	130	<0.07	0	<0.02	3113		0.025

LIBBY CREEK at LB 1000
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	658	0	658	0	569	0	100	35	813	32	<39	3003		100
Ammonia	<0.05	2936	20.31	0	<0.12	0	20.31	0	0.05	35	14.8	32	<0.21	3003		TIN=1
Nitrate	0.05	2936	50.78	0	<0.43	0	50.78	0	0.03	35	32.7	32	0.40	3003		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	0	0.018	0	0.003	35	<0.018	32	<0.004	3003		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	0	<0.018	0	0.002	35	0.014	32	<0.001	3003		0.003
Iron	<0.05	2936	<0.10	0	<0.10	0	0.06	0	0.01	35	<0.08	32	<0.05	3003		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	0	0.161	0	0.005	35	1.97	32	<0.04	3003		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	0	<0.04	0	0.01	35	<0.07	32	<0.02	3003		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	674	0	674	0	583	0	100	291	832	47.3	<48	3274		100
Ammonia	<0.05	2936	20.81	0	<0.12	0	20.81	0	0.05	291	15.2	47.3	<0.27	3274		TIN=1
Nitrate	0.05	2936	5.2	0	<0.44	0	5.2	0	0.03	291	3.4	47.3	0.10	3274		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	0	0.019	0	0.003	291	<0.019	47.3	<0.004	3274		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	0	<0.019	0	0.002	291	0.015	47.3	<0.001	3274		0.003
Iron	<0.05	2936	<0.10	0	<0.10	0	0.06	0	0.01	291	<0.08	47.3	<0.05	3274		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	0	0.165	0	0.005	291	2.02	47.3	<0.05	3274		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	0	<0.04	0	0.01	291	<0.07	47.3	<0.02	3274		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	<30	2936	674	0	674	0	583	0	100	0	832	47.3	<43	2983		100
Ammonia	<0.05	2936	21	0	<0.12	0	20.81	0	0.05	0	15.2	47.3	<0.29	2983		TIN=1
Nitrate	0.05	2936	5	0	<0.44	0	5.2	0	0.03	0	3.4	47.3	0.10	2983		TIN=1
Antimony	<0.004	2936	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	47.3	<0.004	2983		0.0056
Copper	<0.001	2936	<0.002	0	<0.002	0	0.019	0	0.002	0	0.015	47.3	<0.001	2983		0.003
Iron	<0.05	2936	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	47.3	<0.05	2983		0.1
Manganese	<0.02	2936	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	47.3	<0.05	2983		0.05
Zinc	<0.02	2936	<0.11	0	<0.11	0	0.04	0	0.01	0	<0.07	47.3	<0.02	2983		0.025

LIBBY CREEK at LB 2000
Construction

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	658	32	658	0	569	0	100	475	813	0	41	3762		100
Ammonia	<0.05	3255	20.31	32	<0.12	0	20.31	0	0.05	475	14.8	0	<0.22	3762		TIN=1
Nitrate	0.06	3255	50.78	32	<0.43	0	50.78	0	0.03	475	32.7	0	0.49	3762		TIN=1
Antimony	0.002	3255	<0.006	32	<0.006	0	0.018	0	0.003	475	<0.018	0	<0.002	3762		0.0056
Copper	<0.001	3255	<0.002	32	<0.002	0	<0.018	0	0.002	475	0.014	0	<0.001	3762		0.003
Iron	<0.05	3255	<0.10	32	<0.10	0	0.06	0	0.01	475	<0.08	0	<0.05	3762		0.1
Manganese	<0.02	3255	<0.04	32	<0.04	0	0.161	0	0.005	475	1.97	0	<0.02	3762		0.05
Zinc	<0.02	3255	<0.11	32	<0.11	0	<0.04	0	0.01	475	<0.07	0	<0.02	3762		0.025

Alternatives 3 and 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	674	47.3	674	0	583	0	100	201	832	0	39	3503		100
Ammonia	<0.05	3255	20.81	47.3	<0.12	0	20.81	0	0.05	201	15.2	0	<0.33	3503		TIN=1
Nitrate	0.06	3255	5.2	47.3	<0.44	0	5.2	0	0.03	201	3.4	0	0.13	3503		TIN=1
Antimony	<0.002	3255	<0.006	47.3	<0.006	0	0.019	0	0.003	201	<0.019	0	<0.002	3503		0.0056
Copper	<0.001	3255	<0.002	47.3	<0.002	0	<0.019	0	0.002	201	0.015	0	<0.001	3503		0.003
Iron	<0.05	3255	<0.10	47.3	<0.10	0	0.06	0	0.01	201	<0.08	0	<0.05	3503		0.1
Manganese	<0.02	3255	<0.04	47.3	<0.04	0	0.165	0	0.005	201	2.02	0	<0.02	3503		0.05
Zinc	<0.02	3255	<0.11	47.3	<0.11	0	<0.04	0	0.01	201	<0.07	0	<0.02	3503		0.025

LIBBY CREEK at LB 2000
Mining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	658	0	658	10.9	569	21.12	100	164	813	0	35	3451		100
Ammonia	<0.05	3255	20.31	0	<0.12	10.9	20.31	21.12	0.05	164	14.8	0	<0.17	3451		TIN=1
Nitrate	0.06	3255	50.78	0	<0.43	10.9	50.78	21.12	0.03	164	32.7	0	<0.37	3451		TIN=1
Antimony	0.002	3255	<0.006	0	<0.006	10.9	0.018	21.12	0.003	164	<0.018	0	<0.002	3451		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	10.9	<0.018	21.12	0.002	164	0.014	0	<0.001	3451		0.003
Iron	<0.05	3255	<0.10	0	<0.10	10.9	0.06	21.12	0.01	164	<0.08	0	<0.05	3451		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	10.9	0.161	21.12	0.005	164	1.97	0	<0.02	3451		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	10.9	<0.04	21.12	0.01	164	<0.07	0	<0.02	3451		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	674	0	674	16.1	583	31.2	100	350	832	0	41	3652		100
Ammonia	<0.05	3255	20.81	0	<0.12	16.1	20.81	31.2	0.05	350	15.2	0	<0.23	3652		TIN=1
Nitrate	0.06	3255	5.2	0	<0.44	16.1	5.2	31.2	0.03	350	3.4	0	<0.10	3652		TIN=1
Antimony	<0.002	3255	<0.006	0	<0.006	16.1	0.019	31.2	0.003	350	<0.019	0	<0.002	3652		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	16.1	<0.019	31.2	0.002	350	0.015	0	<0.001	3652		0.003
Iron	<0.05	3255	<0.10	0	<0.10	16.1	0.06	31.2	0.01	350	<0.08	0	<0.05	3652		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	16.1	0.165	31.2	0.005	350	2.02	0	<0.02	3652		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	16.1	<0.04	31.2	0.01	350	<0.07	0	<0.02	3652		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	674	0	674	16.1	583	31.2	100	130	832	0	37	3432		100
Ammonia	<0.05	3255	21	0	<0.12	16.1	20.81	31.2	0.05	130	15.2	0	<0.24	3432		TIN=1
Nitrate	0.06	3255	5	0	<0.44	16.1	5.2	31.2	0.03	130	3.4	0	<0.11	3432		TIN=1
Antimony	<0.002	3255	<0.006	0	<0.006	16.1	0.019	31.2	0.003	130	<0.019	0	<0.002	3432		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	16.1	<0.019	31.2	0.002	130	0.015	0	<0.001	3432		0.003
Iron	<0.05	3255	<0.10	0	<0.10	16.1	0.06	31.2	0.01	130	<0.08	0	<0.05	3432		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	16.1	0.165	31.2	0.005	130	2.02	0	<0.02	3432		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	16.1	<0.04	31.2	0.01	130	<0.07	0	<0.02	3432		0.025

LIBBY CREEK at LB 2000
Postmining

Alternative 2

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	658	0	658	0	569	0	100	35	813	32	34	3322		100
Ammonia	<0.05	3255	20.31	0	<0.12	0	20.31	0	0.05	35	14.8	32	<0.19	3322		TIN=1
Nitrate	0.06	3255	50.78	0	<0.43	0	50.78	0	0.03	35	32.7	32	0.37	3322		TIN=1
Antimony	<0.002	3255	<0.006	0	<0.006	0	0.018	0	0.003	35	<0.018	32	<0.002	3322		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	0	<0.018	0	0.002	35	0.014	32	<0.001	3322		0.003
Iron	<0.05	3255	<0.10	0	<0.10	0	0.06	0	0.01	35	<0.08	32	<0.05	3322		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	0	0.161	0	0.005	35	1.97	32	<0.04	3322		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	0	<0.04	0	0.01	35	<0.07	32	<0.02	3322		0.025

Alternative 3

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	674	0	674	0	583	0	100	291	832	47.3	43	3593		100
Ammonia	<0.05	3255	20.81	0	<0.12	0	20.81	0	0.05	291	15.2	47.3	<0.25	3593		TIN=1
Nitrate	0.06	3255	5.2	0	<0.44	0	5.2	0	0.03	291	3.4	47.3	0.10	3593		TIN=1
Antimony	<0.002	3255	<0.006	0	<0.006	0	0.019	0	0.003	291	<0.019	47.3	<0.002	3593		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	0	<0.019	0	0.002	291	0.015	47.3	<0.001	3593		0.003
Iron	<0.05	3255	<0.10	0	<0.10	0	0.06	0	0.01	291	<0.08	47.3	<0.05	3593		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	0	0.165	0	0.005	291	2.02	47.3	<0.05	3593		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	0	<0.04	0	0.01	291	<0.07	47.3	<0.02	3593		0.025

Alternative 4

	Existing Water Quality		Expected adit water from LAD percolation (construction)		Expected adit water from LAD percolation (mining)		Expected mine water from LAD percolation		Expected Water Treatment Plant effluent		Expected tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	26	3255	674	0	674	0	583	0	100	0	832	47.3	38	3302		100
Ammonia	<0.05	3255	21	0	<0.12	0	20.81	0	0.05	0	15.2	47.3	<0.27	3302		TIN=1
Nitrate	0.06	3255	5	0	<0.44	0	5.2	0	0.03	0	3.4	47.3	0.11	3302		TIN=1
Antimony	<0.002	3255	<0.006	0	<0.006	0	0.019	0	0.003	0	<0.019	47.3	<0.002	3302		0.0056
Copper	<0.001	3255	<0.002	0	<0.002	0	0.019	0	0.002	0	0.015	47.3	<0.001	3302		0.003
Iron	<0.05	3255	<0.10	0	<0.10	0	0.06	0	0.01	0	<0.08	47.3	<0.05	3302		0.1
Manganese	<0.02	3255	<0.04	0	<0.04	0	0.165	0	0.005	0	2.02	47.3	<0.05	3302		0.05
Zinc	<0.02	3255	<0.11	0	<0.11	0	0.04	0	0.01	0	<0.07	47.3	<0.02	3302		0.025

LAD--Construction

Alternative 2

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Adit Water Input from LAD Percolation (construction)		Projected Final Mixing Concentration		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	(mg/L)	(mg/L)	(mg/L)
TDS	85	31	658	32	376	63	True	200
Nitrate	<0.49	31	50.78	32	<26.03	63	True	10
Antimony	<0.003	31	<0.006	32	<0.005	63		0.006
Cadmium	<0.0002	31	<0.0006	32	<0.0004	63		0.005
Copper	<0.001	31	<0.002	32	<0.002	63		0.1
Iron	<0.05	31	<0.10	32	<0.08	63		0.2
Lead	<0.001	31	<0.002	32	<0.002	63		0.015
Manganese	<0.04	31	<0.04	32	<0.04	63		0.05
Silver	<0.0002	31	<0.0014	32	<0.001	63		0.1
Zinc	<0.02	31	<0.11	32	<0.07	63		0.1

Alternatives 3 & 4

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Adit Water Input from LAD Percolation (construction)		Projected Final Mixing Concentration		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	(mg/L)	(mg/L)	(mg/L)
TDS	85	46	674	47.3	384	93.3	True	200
Nitrate	<0.49	46	5	47.3	<2.88	93.3		10
Antimony	<0.003	46	<0.006	47.3	<0.005	93.3		0.006
Cadmium	<0.0002	46	<0.0006	47.3	<0.0004	93.3		0.005
Copper	<0.001	46	<0.002	47.3	<0.002	93.3		0.1
Iron	<0.05	46	<0.10	47.3	<0.08	93.3		0.2
Lead	<0.001	46	<0.002	47.3	<0.002	93.3		0.015
Manganese	<0.04	46	<0.04	47.3	<0.04	93.3		0.05
Silver	<0.0002	46	<0.0010	47.3	<0.001	93.3		0.1
Zinc	<0.02	46	<0.11	47.3	<0.07	93.3		0.1

LAD--Mining

Alternative 2

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Adit Water Input from LAD Percolation (operational)		Expected Mine Water Input from LAD Percolation (operational)		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	85	31	658	10.9	569	21.1	346	63	True	200
Nitrate	<0.49	31	<0.43	10.9	50.78	21.1	<17.32	63	True	10
Antimony	<0.003	31	<0.006	10.9	0.018	21.1	<0.009	63	True	0.006
Cadmium	<0.0002	31	<0.0006	10.9	<0.0004	21.1	<0.0003	63		0.005
Copper	<0.001	31	<0.002	10.9	<0.018	21.1	<0.007	63		0.1
Iron	<0.05	31	<0.10	10.9	0.06	21.1	<0.06	63		0.2
Lead	<0.001	31	<0.002	10.9	<0.001	21.1	<0.001	63		0.015
Manganese	<0.04	31	<0.04	10.9	0.161	21.1	<0.08	63	True	0.05
Silver	<0.0002	31	<0.0014	10.9	<0.006	21.1	<0.002	63		0.1
Zinc	<0.02	31	<0.11	10.9	<0.04	21.1	<0.04	63		0.1

Alternatives 3 & 4

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Adit Water Input from LAD Percolation (operational)		Expected Mine Water Input from LAD Percolation (operational)		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	85	46	674	16.1	583	31.2	353	93.3	True	200
Nitrate	<0.49	46	<0.44	16.1	5.2	31.2	<2.06	93.3		10
Antimony	<0.003	46	<0.006	16.1	0.019	31.2	<0.009	93.3	True	0.006
Cadmium	<0.0002	46	<0.0006	16.1	<0.0004	31.2	<0.0003	93.3		0.005
Copper	<0.001	46	<0.002	16.1	<0.019	31.2	<0.007	93.3		0.1
Iron	<0.05	46	<0.10	16.1	0.06	31.2	<0.06	93.3		0.2
Lead	<0.001	46	<0.002	16.1	<0.001	31.2	<0.001	93.3		0.015
Manganese	<0.04	46	<0.04	16.1	0.165	31.2	<0.08	93.3	True	0.05
Silver	<0.0002	46	<0.0015	16.1	<0.006	31.2	<0.002	93.3		0.1
Zinc	<0.02	46	<0.11	16.1	<0.04	31.2	<0.04	93.3		0.1

LAD--Post-Mining

Alternative 2

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Tailing Water Input from LAD Percolation (post-mining)		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	85	31	813	32	455	63	True	200
Nitrate	<0.49	31	32.7	32	<16.85	63	True	10
Antimony	<0.003	31	<0.018	32	<0.011	63	True	0.006
Cadmium	<0.0002	31	<0.004	32	<0.0021	63		0.005
Copper	<0.001	31	0.014	32	<0.008	63		0.1
Iron	<0.05	31	<0.08	32	<0.07	63		0.2
Lead	<0.001	31	<0.005	32	<0.003	63		0.015
Manganese	<0.04	31	1.97	32	<1.02	63	True	0.05
Silver	<0.0002	31	<0.008	32	<0.004	63		0.1
Zinc	<0.02	31	<0.07	32	<0.05	63		0.1

Alternatives 3 & 4

Mass Balance Calculations for ground water below LAD Areas

	Existing Ground Water Conditions		Expected Tailing Water Input from LAD Percolation (post-mining)		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	85	32	832	47.3	531	79.3	True	200
Nitrate	<0.49	32	3.4	47.3	<2.20	79.3		10
Antimony	<0.003	32	<0.019	47.3	<0.013	79.3	True	0.006
Cadmium	<0.0002	32	<0.004	47.3	<0.0025	79.3		0.005
Copper	<0.001	32	0.015	47.3	<0.009	79.3		0.1
Iron	<0.05	32	<0.08	47.3	<0.07	79.3		0.2
Lead	<0.001	32	<0.005	47.3	<0.003	79.3		0.015
Manganese	<0.04	32	2.02	47.3	<1.22	79.3	True	0.05
Silver	<0.0002	32	<0.008	47.3	<0.005	79.3		0.1
Zinc	<0.02	32	<0.07	47.3	<0.05	79.3		0.1

TI--Construction
Little Cherry Creek Impoundment Area Well Data Used for Existing Conditions

Alternatives 2 & 4
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	99	35	200	11	123	46		200
Nitrate	0.1	35	16.1	11	3.9	46		10
Antimony	<0.003	35	0.009	11	<0.004	46		0.006
Cadmium	<0.001	35	0.002	11	<0.001	46		0.005
Copper	<0.01	35	0.035	11	<0.02	46		0.1
Iron	<0.05	35	<0.04	11	<0.05	46		0.2
Lead	<0.01	35	<0.013	11	<0.01	46		0.015
Manganese	<0.03	35	0.54	11	<0.15	46	True	0.05
Silver	<0.001	35	<0.004	11	<0.002	46		0.1
Zinc	<0.02	35	<0.02	11	<0.02	46		0.1

Poorman Impoundment Area Well Data Used for Existing Conditions
Alternative 3
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	102	41	200	11	123	52		200
Nitrate	<0.07	41	16.1	11	<3.5	52		10
Antimony	<0.003	41	0.009	11	<0.004	52		0.006
Cadmium	<0.001	41	0.002	11	<0.001	52		0.005
Copper	<0.01	41	0.035	11	<0.02	52		0.1
Iron	<0.05	41	<0.04	11	<0.05	52		0.2
Lead	<0.01	41	<0.013	11	<0.01	52		0.015
Manganese	<0.02	41	0.54	11	<0.13	52	True	0.05
Silver	<0.001	41	<0.004	11	<0.002	52		0.1
Zinc	<0.02	41	<0.02	11	<0.02	52		0.1

Tailings Impoundment--Mining
Little Cherry Creek Impoundment Area Well Data Used for Existing Conditions

Alternatives 2 & 4
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	99	35	200	25	141	60		200
Nitrate	0.1	35	16.1	25	6.8	60		10
Antimony	<0.003	35	0.009	25	<0.006	60		0.006
Cadmium	<0.001	35	0.002	25	<0.001	60		0.005
Copper	<0.01	35	0.035	25	<0.02	60		0.1
Iron	<0.05	35	<0.04	25	<0.05	60		0.2
Lead	<0.01	35	<0.013	25	<0.01	60		0.015
Manganese	<0.03	35	0.54	25	<0.24	60	True	0.05
Silver	<0.001	35	<0.004	25	<0.002	60		0.1
Zinc	<0.02	35	<0.02	25	<0.02	60		0.1

Poorman Impoundment Area Well Data Used for Existing Conditions
Alternative 3
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	102	41	200	25	139	66		200
Nitrate	<0.07	41	16.1	25	<6.1	66		10
Antimony	<0.003	41	0.009	25	<0.005	66		0.006
Cadmium	<0.001	41	0.002	25	<0.001	66		0.005
Copper	<0.01	41	0.035	25	<0.02	66		0.1
Iron	<0.05	41	<0.04	25	<0.05	66		0.2
Lead	<0.01	41	<0.013	25	<0.01	66		0.015
Manganese	<0.02	41	0.54	25	<0.22	66	True	0.05
Silver	<0.001	41	<0.004	25	<0.002	66		0.1
Zinc	<0.02	41	<0.02	25	<0.02	66		0.1

Tailings Impoundment--Post-Closure
Little Cherry Creek Impoundment Area Well Data Used for Existing Conditions

Alternatives 2 & 4
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	99	35	200	5	112	40		200
Nitrate	0.1	35	16.1	5	2.1	40		10
Antimony	<0.003	35	0.009	5	<0.004	40		0.006
Cadmium	<0.001	35	0.002	5	<0.001	40		0.005
Copper	<0.01	35	0.035	5	<0.01	40		0.1
Iron	<0.05	35	<0.04	5	<0.05	40		0.2
Lead	<0.01	35	<0.013	5	<0.01	40		0.015
Manganese	<0.03	35	0.54	5	<0.09	40	True	0.05
Silver	<0.001	35	<0.004	5	<0.001	40		0.1
Zinc	<0.02	35	<0.02	5	<0.02	40		0.1

Poorman Impoundment Area Well Data Used for Existing Conditions
Alternative 3
Mass Balance Calculations for ground water below TI

	Existing Ground water Conditions		Expected Tailing Water Input from Seepage		Projected Final Mixing Concen.		Change in concentration	Ground Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	(mg/L)	(mg/L)
TDS	102	41	200	5	113	46		200
Nitrate	<0.07	41	16.1	5	<1.8	46		10
Antimony	<0.003	41	0.009	5	<0.004	46		0.006
Cadmium	<0.001	41	0.002	5	<0.001	46		0.005
Copper	<0.01	41	0.035	5	<0.01	46		0.1
Iron	<0.05	41	<0.04	5	<0.05	46		0.2
Lead	<0.01	41	<0.013	5	<0.01	46		0.015
Manganese	<0.02	41	0.54	5	<0.08	46	True	0.05
Silver	<0.001	41	<0.004	5	<0.001	46		0.1
Zinc	<0.02	41	<0.02	5	<0.02	46		0.1

Alternative 2

RA 600 PM 1200 LB 1000

During Construction							
TDS	<30	<33	<45	100			
Ammonia	<0.59	<0.45	<0.24	TIN=1	True	True	
Nitrate	<1.42	<1.06	0.52	TIN=1	True	True	
	<2.01	<1.51	<0.76				
Antimony	<0.003	<0.003	<0.004	0.0056			
Copper	<0.001	<0.001	<0.001	0.003			
Iron	<0.05	<0.05	<0.04	0.1			
Manganese	<0.02	<0.02	<0.02	0.05			
Zinc	<0.02	<0.02	<0.02	0.025			
During Mining							
TDS	<29	<32	<39	100			
Ammonia	<0.41	<0.32	<0.19	TIN=1	True	True	
Nitrate	<0.97	<0.73	<0.39	TIN=1	True	True	
	<1.38	<1.05	<0.58				
Antimony	<0.003	<0.003	<0.004	0.0056			
Copper	<0.001	<0.001	<0.001	0.003			
Iron	<0.05	<0.05	<0.05	0.1			
Manganese	<0.02	<0.02	<0.02	0.05			
Zinc	<0.02	<0.02	<0.02	0.025			
During Post-mining							
TDS	<34	<36	<39	100			
Ammonia	<0.45	<0.34	<0.21	TIN=1	True	True	
Nitrate	<0.93	<0.70	0.40	TIN=1	True	True	
	<1.38	<1.04	<0.61				
Antimony	<0.003	<0.003	<0.004	0.0056			
Copper	<0.001	<0.001	<0.001	0.003			
Iron	<0.05	<0.05	<0.05	0.1			
Manganese	<0.07	<0.06	<0.04	0.05	True	True	
Zinc	<0.02	<0.02	<0.02	0.025			

Alternative 3

RA 600 PM 1200 LB 1000

<42	<40	<44	100			
<0.95	<0.69	<0.36	TIN=1	True		
<0.28	<0.21	0.13	TIN=1	True		
<1.23	<0.90	<0.48				
<0.003	<0.003	<0.004	0.0056			
<0.001	<0.001	<0.001	0.003			
<0.05	<0.05	<0.05	0.1			
<0.02	<0.02	<0.02	0.05			
<0.02	<0.02	<0.02	0.025			

<40	<38	<46	100			
<0.36	<0.47	<0.24	TIN=1			
<0.15	<0.16	<0.10	TIN=1			
<0.50	<0.63	<0.34				
<0.003	<0.003	<0.004	0.0056			
<0.001	<0.001	<0.001	0.003			
<0.05	<0.05	<0.05	0.1			
<0.02	<0.02	<0.02	0.05			
<0.02	<0.02	<0.02	0.025			

<48	<45	<48	100			
<0.70	<0.52	<0.27	TIN=1			
<0.20	<0.15	0.10	TIN=1			
<0.91	<0.67	<0.36				
<0.004	<0.003	<0.004	0.0056			
<0.002	<0.001	<0.001	0.003			
<0.05	<0.05	<0.05	0.1			
<0.11	<0.08	<0.05	0.05	True	True	
<0.02	<0.02	<0.02	0.025			

LAD Areas

During Construction

TDS	376	384
Nitrate	<26.03	<2.88
Antimony	<0.005	<0.005
Cadmium	<0.0004	<0.0004
Copper	<0.002	<0.002
Iron	<0.08	<0.08
Lead	<0.002	<0.002
Manganese	<0.04	<0.04
Silver	<0.001	<0.001
Zinc	<0.07	<0.07
Maxmining		
TDS	346	353
Nitrate	<17.32	<2.06
Antimony	<0.009	<0.009
Cadmium	<0.0003	<0.0003
Copper	<0.007	<0.007
Iron	<0.06	<0.06
Lead	<0.001	<0.001
Manganese	<0.08	<0.08
Silver	<0.002	<0.002
Zinc	<0.04	<0.04
Postj-mining		
TDS	455	531
Nitrate	<16.85	<2.20
Antimony	<0.011	<0.013
Cadmium	<0.0021	<0.0025
Copper	<0.008	<0.009
Iron	<0.07	<0.07
Lead	<0.003	<0.003
Manganese	<1.02	<1.22
Silver	<0.004	<0.005
Zinc	<0.05	<0.05

Tailings Impoundment

During Construction

TDS	123	123
Nitrate	<3.9	<3.5
Antimony	<0.004	<0.004
Cadmium	<0.001	<0.001
Copper	<0.02	<0.02
Iron	<0.05	<0.05
Lead	<0.01	<0.01
Manganese	<0.15	<0.13
Silver	<0.002	<0.002
Zinc	<0.02	<0.02
Maxmining		
TDS	141	139
Nitrate	6.8	<6.1
Antimony	<0.006	<0.005
Cadmium	<0.001	<0.001

Copper	<0.02	<0.02
Iron	<0.05	<0.05
Lead	<0.01	<0.01
Manganese	<0.24	<0.22
Silver	<0.002	<0.002
Zinc	<0.02	<0.02
Postmining		
TDS	112	113
Nitrate	2.1	<1.8
Antimony	<0.004	<0.004
Cadmium	<0.001	<0.001
Copper	<0.01	<0.01
Iron	<0.05	<0.05
Lead	<0.01	<0.01
Manganese	<0.09	<0.08
Silver	<0.001	<0.001
Zinc	<0.02	<0.02

Appendix H—Various Streamflow Analyses

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March 10, 2008

To: Montanore Mine Project EIS

From: Jack Denman, Richard Trenholme, ERO Resources Corporation

Re: Montanore Tailings Impoundment Watershed Analysis

This memorandum presents the findings of an analysis of the changes to watershed boundaries resulting from the various tailings impoundment locations for each of the three alternatives (Alternatives 2, 3, and 4) for the Montanore Project. The purpose of the analysis is to assess changes in watershed areas as an indicator of possible streamflow changes.

The primary assumption of this analysis is that watershed area, as a direct measure of catchment area, is directly related to streamflow of the receiving stream in each watershed. Additional assumptions are:

1. Differences in precipitation and runoff due to elevation, soil type, vegetative cover, slope, aspect or other physical, biological, or geologic characteristics of the watershed are negligible across the analysis area. Within the small watersheds of the tailings impoundment sites, differences in elevation are slight.
2. All surface runoff in contact with tailings during operational periods would be intercepted and pumped to the mill for use.
3. The South Saddle Dam and Main Dam (Alternatives 2 and 4) and the Main Dam and Seepage Collection Dam (Alternative 3) would be constructed of tailings, and surface runoff would be pumped to mill.
4. The North Saddle Dam and Diversion Dam (Alternatives 2 and 4) and the Saddle Dam (Alternative 3) would be constructed of local soil and rock, not tailings, and surface runoff would be managed as stormwater and flow into nearby streams.
5. Surface runoff associated with soil stockpiles located across existing watersheds would remain within the respective existing watershed.
6. Surface runoff from the borrow areas outside of the impoundment footprint in Alternatives 2 and 4 would be channeled to Bear Creek during operations and graded to flow into the tailings impoundment upon closure.
7. Seepage collection dams would be removed as part of mine closure.

Watershed Calculations

For the purpose of this analysis, the existing proposed footprints for the three tailings impoundments and associated facilities were plotted over the Hydrographic Unit boundaries. The boundaries were a GIS coverage provided by the Kootenai National Forest (KNF). ERO altered one hydrographic unit, the Libby Creek Upper Tributary, from that provided by the KNF. The altered unit is between Little Cherry Creek and Poorman Creek, and is the unit in which most of the Poorman Tailings Impoundment in Alternative 3 would be located. ERO altered the boundary based on studies of the Diversion Channel and the Poorman Impoundment Site. Kline (2005) reported that the USGS topographic map indicates the diverted stream (between National Forest Service (NFS) roads #6212 and #5181) would flow to the southeast. The field survey revealed that the stream would flow to the northeast and discharge to Libby Creek 1,900 feet downstream of the location indicated on the topographic map. Geomatrix (2006) labeled this stream Channel A. Kline (2005) reported that a closed spur of NFS road #5181 has a culvert to convey the diverted stream and another culvert 1,157 feet to the south. The diverted stream would not naturally flow to the south culvert. According to Kline (2005), it was often difficult to judge where water would flow downgradient of NFS road #5181. Geomatrix (2006) described this south channel as Channel B. In a wetland delineation of the Poorman Impoundment Site, Geomatrix (2007) identified four channels between Little Cherry Creek and Poorman Creek. MMC proposes to divert flows up to about 20 cfs into Channel A, and higher flows into both channels (Geomatrix 2007). Based on these reports and air photo-interpretation, ERO delineated a watershed for Channel A, and a separate watershed for Channel B and the other two channels. The watershed for Channel A is labeled Channel A for this analysis; the watershed for Channel B and the other two channels is labeled Channel BCD.

Each impoundment feature and associated "sub-watershed" was mapped as a polygon using ArcGIS. The mapping enabled an impact area to be calculated for each feature by watershed. For example, precipitation intercepted by the impoundment surface, Main Dam, South Saddle Dam, and Seepage Collection Dam in Alternatives 2 and 4 would be intercepted and sent to the mill. For Alternative 2, this sub-watershed is labeled LCC-2. Likewise, precipitation upstream of the Diversion Dam in Alternative 2 would be diverted into Channel A. This sub-watershed is labeled LCC-5. For purposes of analysis, it was assumed all water upstream of the Diversion Dam in Alternatives 2 and 4 would be diverted into Channel A. This assumption would accurately reflect relative change except during high flow periods, when some flow would flow to Channel B in the Channel BCD watershed. Changes to all watersheds were either added or subtracted from the existing watershed area, depending on whether the change would add watershed area, and therefore "water" to the watershed, or remove it. Total watershed areas were calculated from the location on the receiving stream that would receive diverted "watershed area." As a quality control check, the summation of all diversion areas equal to zero was checked for each scenario to ensure that areas were not counted twice. Finally, percent change in the watershed was calculated for each measurement location of receiving streams to qualitatively estimate potential changes in flow associated with the diversions. Calculations for all

three alternatives were performed, for both operational periods and post-closure based on the general conditions of operation and closure discussed in this memorandum.

Watershed Analysis – Alternative 2

Changes to watershed areas during Alternative 2 operations are shown on Figure 1. Surface runoff from the west face of the Diversion Dam and the Little Cherry Creek watershed upstream of the tailings impoundment (LCC-5) would be diverted to Channel A via the engineered diversion channel. This diversion would become the "new" Little Cherry Creek. The watershed of Channel A would increase during operations from 237 acres to 974 acres. Some high flows would be directed into Channel B. During operations, all surface water in contact with tailings and within the sub-watershed of the Seepage Collection Dam (LCC-2, CHA-2, and BC-1) would be pumped to the mill. These diversions would reduce the watershed of the former Little Cherry Creek from 1,682 acres to 225 acres. The watersheds of two locations in Bear Creek would increase slightly (Table 1). Surface runoff from the borrow area uphill from the tailings impoundment (LCC-4) would be diverted around the Diversion Dam, ultimately into Channel A. Surface runoff from the north face of the North Saddle Dam (LCC-3) would be treated as storm runoff and diverted to Bear Creek.

Alternative 2 post-closure changes to watershed areas are shown on Figure 2. The surface of the tailings impoundment would be graded so that drainage west of the Main Dam crest and north of the South Saddle Dam crest would flow toward Bear Creek. The diversion channel that allowed drainage from the borrow area (LCC-4) would be removed to allow flow into the tailings impoundment and north to Bear Creek with the tailings impoundment surface flow (LCC-6). The watershed area in Bear Creek would increase by 560 acres.

The Seepage Collection Dam would be removed and the former Little Cherry Creek watershed would extend west to the crest of the Main Dam. Runoff east of the Main Dam crest would remain in the former Little Cherry Creek watershed (LCC-8). Similarly, surface runoff upstream of the Diversion Dam face (LCC-7) and south of the South Saddle Dam face (CHA-13) would remain in the Channel A watershed upon closure. After closure, Channel A would have a watershed 678 acres larger than its current 237 acres (Table 1). The Libby Creek watershed at the confluence of Channel A would have a slightly larger watershed (678 acre or 3 percent). Between the confluence of the former Little Cherry Creek and Bear Creek, the Libby Creek watershed would have a slightly smaller watershed (560 acres or 2 percent) compared to existing areas. The Libby Creek watershed above the confluence with Bear Creek, would remain unchanged (Table 1).

Table 1. Changes in Watershed Areas during Operations and Closure, Alternative 2.

	Bear Creek		Former Little Cherry Creek	Channel A	Libby Creek		
Measurement Location	BC-7208	BC-8281	LCC-1682	CHA-A-237	LC-23245	LC-25637	LC-35853
Existing Watershed Area (ac.)	7,208	8,281	1,682	237	23,245	25,637	35,853
Operations							
Change in Watershed (ac.)	8	2	-1,457	737	737	-720	-720
New Watershed Area (ac.)	7,217	8,283	225	974	23,982	24,917	35,135
% Change	<1%	<1%	-87%	311%	3%	-3%	-2%
Closure							
Change in Watershed (ac.)	560	560	-1,238	678	678	-560	0
New Watershed Area (ac.)	7,768	8,841	445	915	23,923	25,077	35,853
% Change	8%	7%	-74%	286%	3%	-2%	0%

Watershed Analysis – Alternative 3

Alternative 3 operational changes to the existing watersheds are shown in Figure 3. During operations, surface runoff in contact with tailings and the Main Dam face, and within the Seepage Collection Dam sub-watershed (CHA-4, CHBD-1, LC-3, LC-4, LCC-9, LCC-10, and LCC-11), would be diverted to the mill. Surface runoff from the Saddle Dam face (CHA-5) would be diverted to Little Cherry Creek. Surface runoff from the western watershed boundary of Channels BCD to the western extent of tailings (CHA-6, CHBD-2, and CHBD-3) would be diverted based on a topographic divide between Channels C and D, with runoff from the northern sub-watershed (CHA-6 and CHBD-3) diverted to Little Cherry Creek; and runoff from the southern sub-watershed (CHBD-2) diverted to Poorman Creek. Runoff from the southern portion of the Channel BCD watershed (CHBD-4) would be diverted to Libby Creek because of topographic isolation from the remaining Channel BCD watershed by the Main Dam. These diversions would reduce the watershed of Channel BCD from 759 acres to 117 acres. The watersheds of Poorman Creek and Little Cherry Creek would increase during operation by 146 and 79 acres, respectively (Table 2). The Libby Creek watershed between Poorman Creek and Channels BCD would increase slightly (166 acres or 1 percent), and decrease slightly between Channels BCD and the confluence of Channel A and Libby Creek (690 acres or 3 percent).

Alternative 3 post-closure changes to existing watersheds are shown on Figure 4. After closure, the surface of the tailings impoundment would be graded to allow surface runoff from the impoundment to flow toward Little Cherry Creek. A portion of the northern face of the Main Dam (CHA-11) would flow into the Little Cherry Creek drainage because of the elevation of the final dam face. The drainage channel that allowed surface runoff from the western portion of the Channel BCD watershed to flow to Poorman Creek (during operations) would be removed and graded to allow all surface drainage to flow toward Little Cherry Creek (CHBD-6, CHBD-8, and CHA-

8). These changes would increase the watershed of Little Cherry Creek from 1,457 to 2,101 acres. The Poorman Creek watershed would remain unchanged at closure, compared to the pre-operation size of the watershed.

Surface runoff from the face of the Main Dam would remain in the respective watersheds of final construction (sub-watersheds CHA-7, CHBD-5, CHBD-7, LCC-9, LCC-10 and LC-3). The Seepage Collection Dam would be removed prior to closure (LC-3). Surface runoff from the south face of the Main Dam (CHBD-7) and the southern extent of the Channel BCD watershed (CHBD-4) would flow to Libby Creek because of the topographic isolation described above during operations. The Libby Creek watershed above the confluence with Little Cherry Creek, would remain unchanged (Table 2).

Table 2. Changes in Watershed Areas during Operations and Closure, Alternative 3.

	Poorman Creek	**Little Cherry Creek**		**Channel A**	**Channel BCD**	**Libby Creek**		
Measurement Location	PC-3651	LCC-940	LCC-1457	CHA-A-247	CHA-BCD-759	LC-21482	LC-23245	LC-25637
Existing Watershed Area (ac.)	3,651	940	1,457	247	759	21,482	23,245	25,637
Operations								
Change in Watershed (ac.)	146	77	79	-204	-642	166	-690	-611
New Watershed Area (ac.)	3,797	1,017	1,536	43	117	21,648	22,555	25,026
% Change	4%	8%	5%	-83%	-85%	1%	-3%	-2%
Closure								
Change in Watershed (ac.)	0	633	644	-157	-546	60	-644	0
New Watershed Area (ac.)	3,651	1,573	2,101	90	213	21,542	22,601	25,637
% Change	<1%	67%	44%	-64%	-72%	<1%	-3%	0%

Watershed Analysis – Alternative 4

Alternative 4 operational changes to existing watersheds are shown in Figure 5. Surface water drainage during operations is similar to Alternative 2, with all surface runoff in contact with tailings to be pumped to the mill (LCC-14, CHA-2, and BC-1). Surface runoff from the North Saddle Dam face (LCC-3) would flow to Bear Creek. The watershed of Bear Creek would increase by about 2 to 8 acres (Table 3). A diversion ditch at the base of the borrow area (LCC-15) would divert surface runoff as stormwater to the diversion dam. Surface runoff from the Little Cherry Creek watershed above the Diversion Dam (LCC-13) and the soil borrow area (LCC-15) would be conveyed to Channel A. Tailings runoff diversion to the mill and Channel A diversions would reduce the watershed of Little Cherry Creek by 1,457 acres and increase the watershed of Channel A by 737 acres.

Alternative 4 changes to existing watersheds after closure are shown in Figure 6. The primary difference between Alternatives 2 and 4 is in closure. In Alternative 4, the Tailings Impoundment would be sloped to allow drainage to the southwest, around the Diversion Dam. The diversion ditch at the base of the borrow area would allow flow

to the Tailings Impoundment and subsequently to Channel A. Flows from the Tailings Impoundment (LCC-15 and LCC-16), and from the Little Cherry Creek watershed above the Diversion Dam (LCC-18), would be diverted to Channel A. The Seepage Collection Dam would be removed prior to closure. Surface flow from the dam faces would flow downhill to the receiving watershed, post-closure. These changes would decrease the watershed of Little Cherry Creek by 1,242 acres. The Channel A watershed would increase by 1,234 acres. The Libby Creek watershed, above the confluence with Bear Creek, would remain unchanged (Table 3).

Table 3. Changes in Watershed Areas during Operations and Closure, Alternative 4.

	Bear Creek		**Little Cherry Creek**		**Channel A**	**Libby Creek**		
Measurement Location	BC-7208	BC-8281	LCC-1457	LCC-1682	CHA-A-237	LC-23245	LC-25637	LC-35,853
Existing Watershed Area (ac.)	7,208	8,281	1,457	1,682	237	23,245	25,637	35,853
Operations								
Change in Watershed (ac.)	8	2	-1,457	-1,457	737	737	-720	-720
New Watershed Area (ac.)	7,216	8,283	0	225	974	23,982	25,242	35,102
% Change	<1%	<1%	-100%	-87%	311%	3%	-3%	-2%
Closure								
Change in Watershed (ac.)	8	8	-1,242	-1,242	1,234	1,234	-8	0
New Watershed Area (ac.)	7,216	8,289	215	440	1,470	24,478	25,629	35,853
% Change	<1%	<1%	-85%	-74%	520%	5%	<1%	0%

References

Geomatrix Consultants, Inc. 2006. Analysis of conceptual tailings impoundment diversion drainage alternatives, Montanore Mine Project. Submitted to the KNF and the DEQ. p. 41 plus appendices.

Geomatrix Consultants, Inc. 2007. Survey of wetlands, sensitive plants, and amphibian/reptiles in alternative sites for tailings impoundment, plant facility and mine tunnel, Montanore Mine Project. Prepared for Montanore Minerals Corp. p. 15 plus appendices.

Kline Environmental Research, LLC. 2005. Montanore Project: Fish habitat potential in the Little Cherry Creek tailings impoundment diversion. Submitted to the KNF and the DEQ. p. 20 plus appendices.

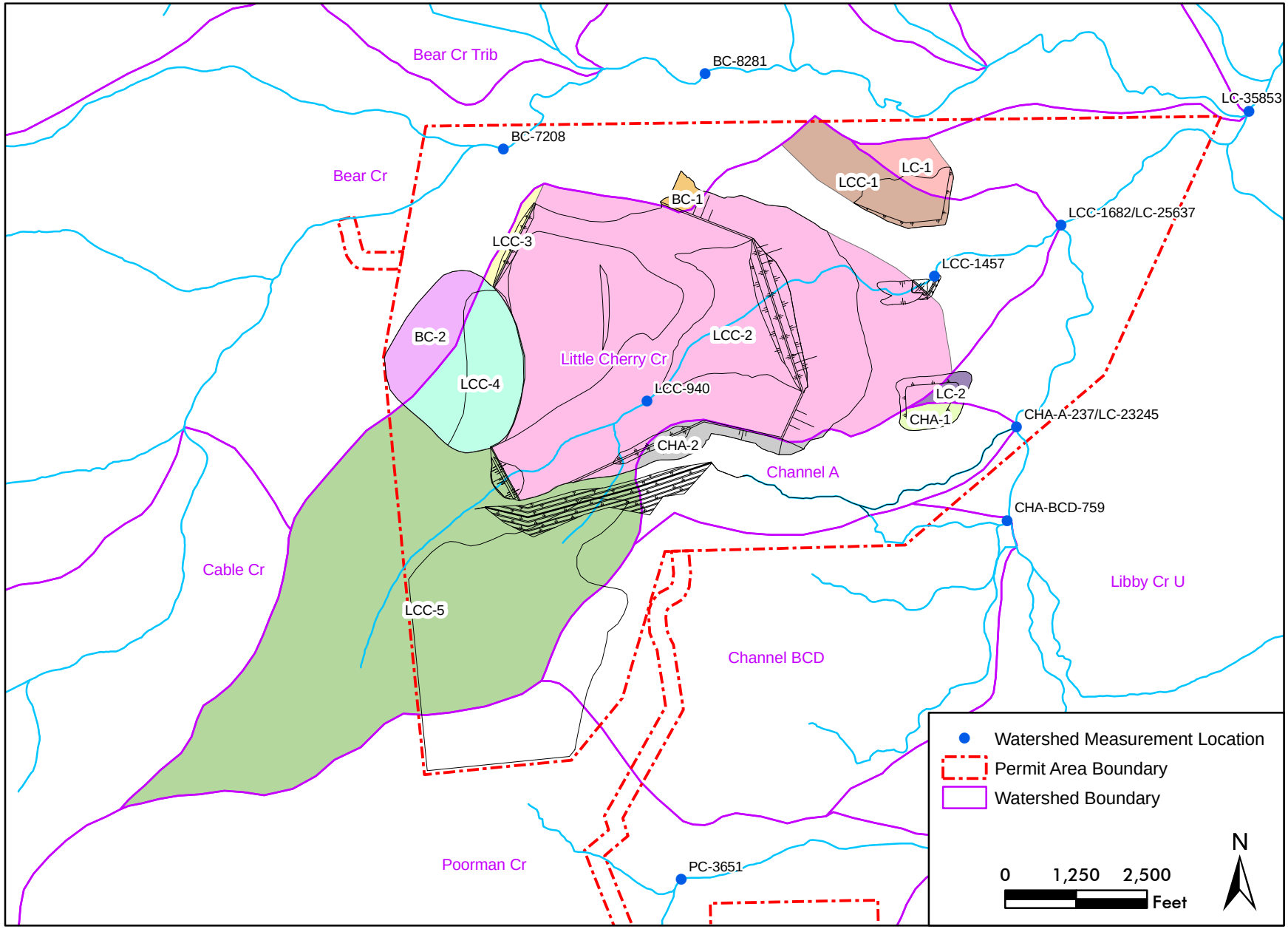


Figure 1. Watershed Analysis, Alternative 2 Operations

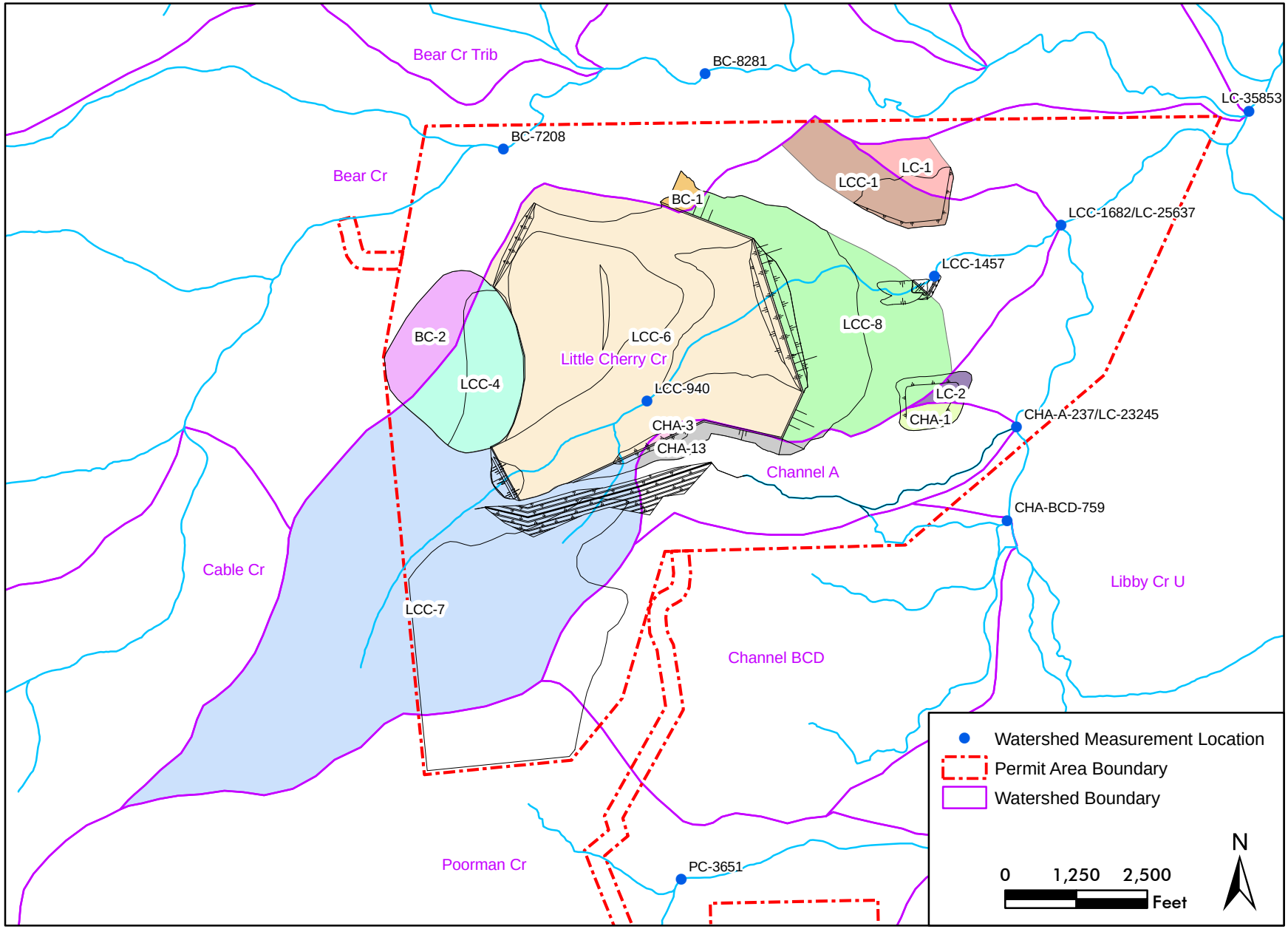


Figure 2. Watershed Analysis, Alternative 2 Closure

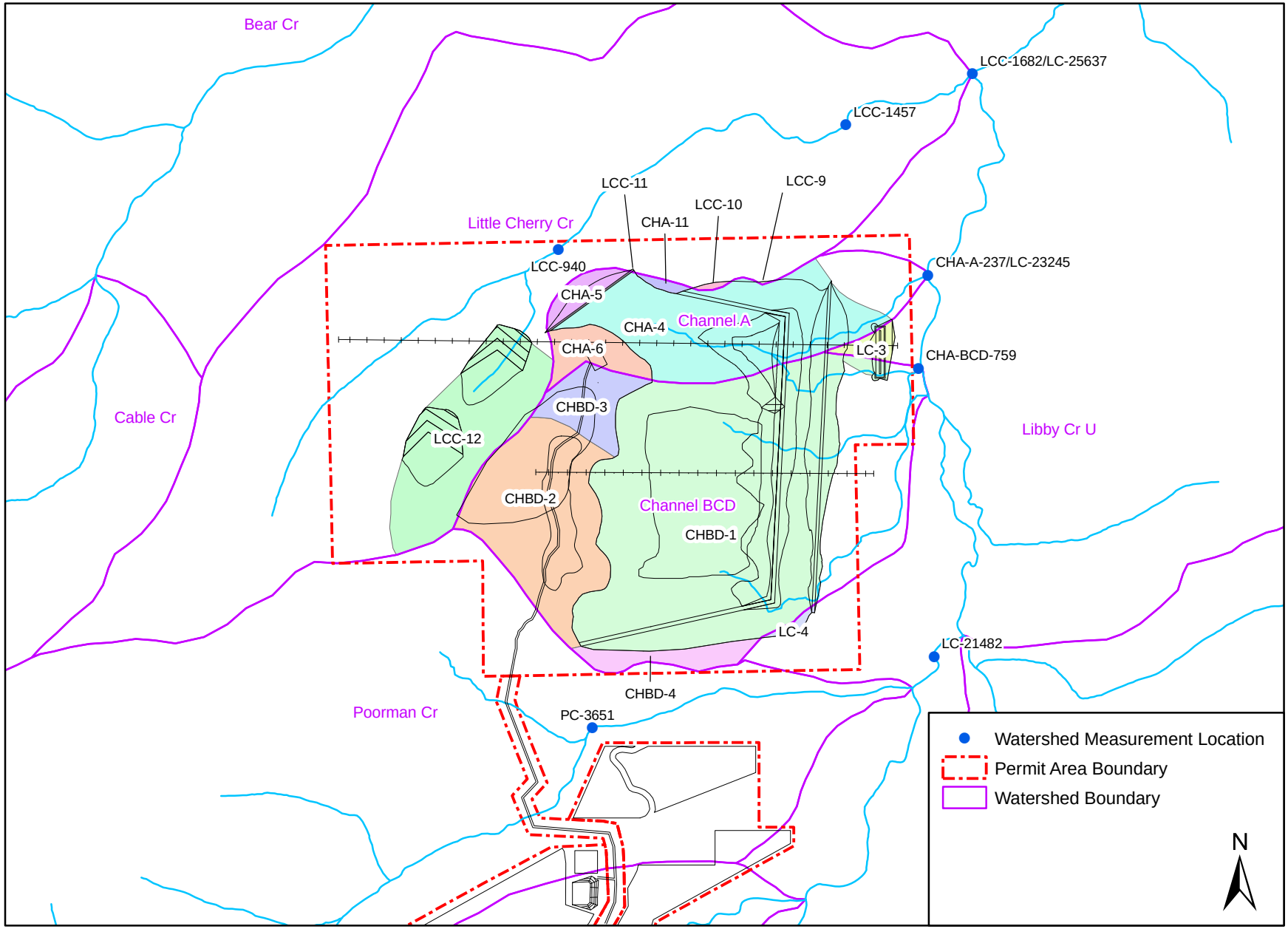


Figure 3. Watershed Analysis, Alternative 3 Operations

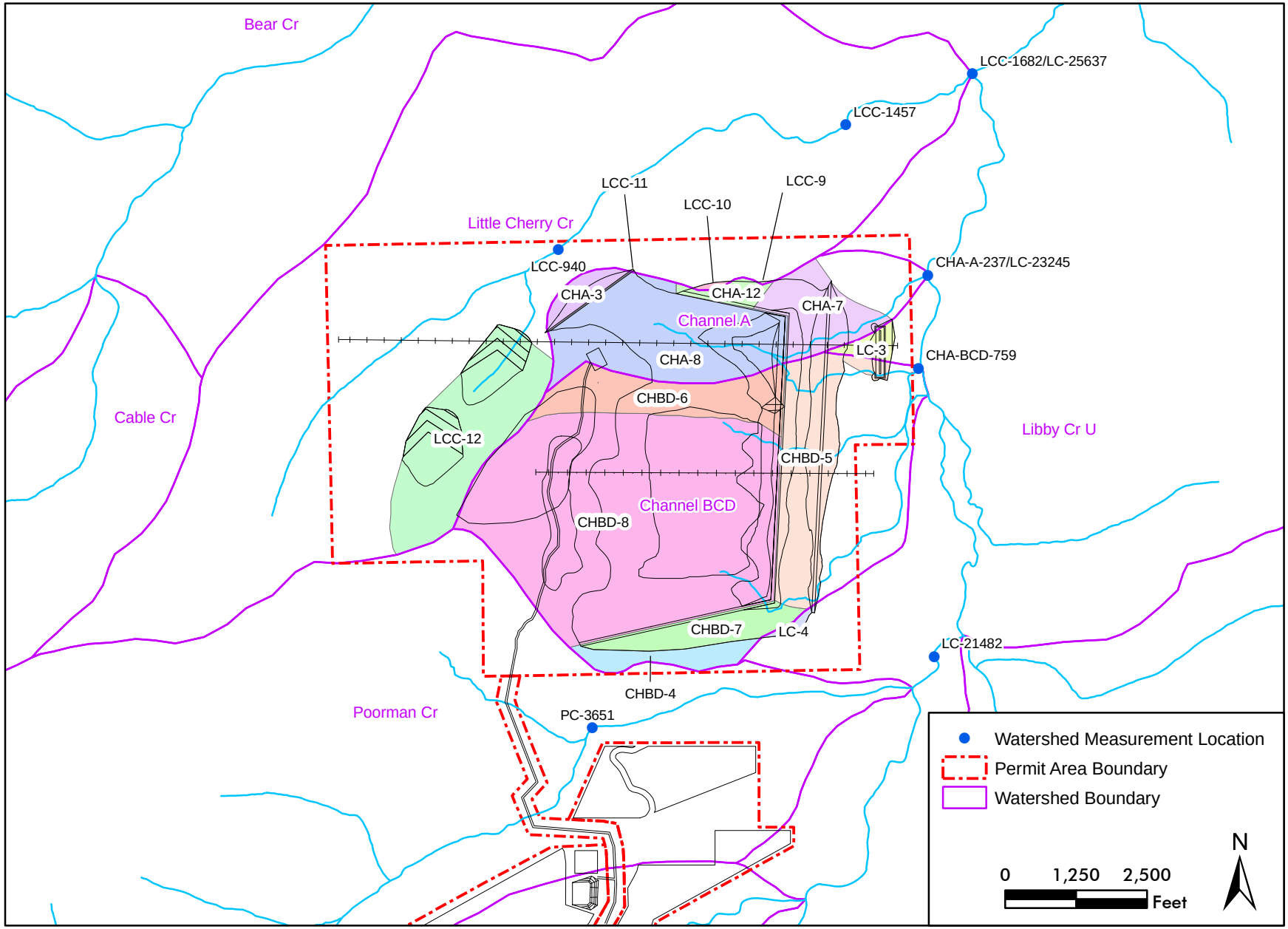


Figure 4. Watershed Analysis, Alternative 3 Closure

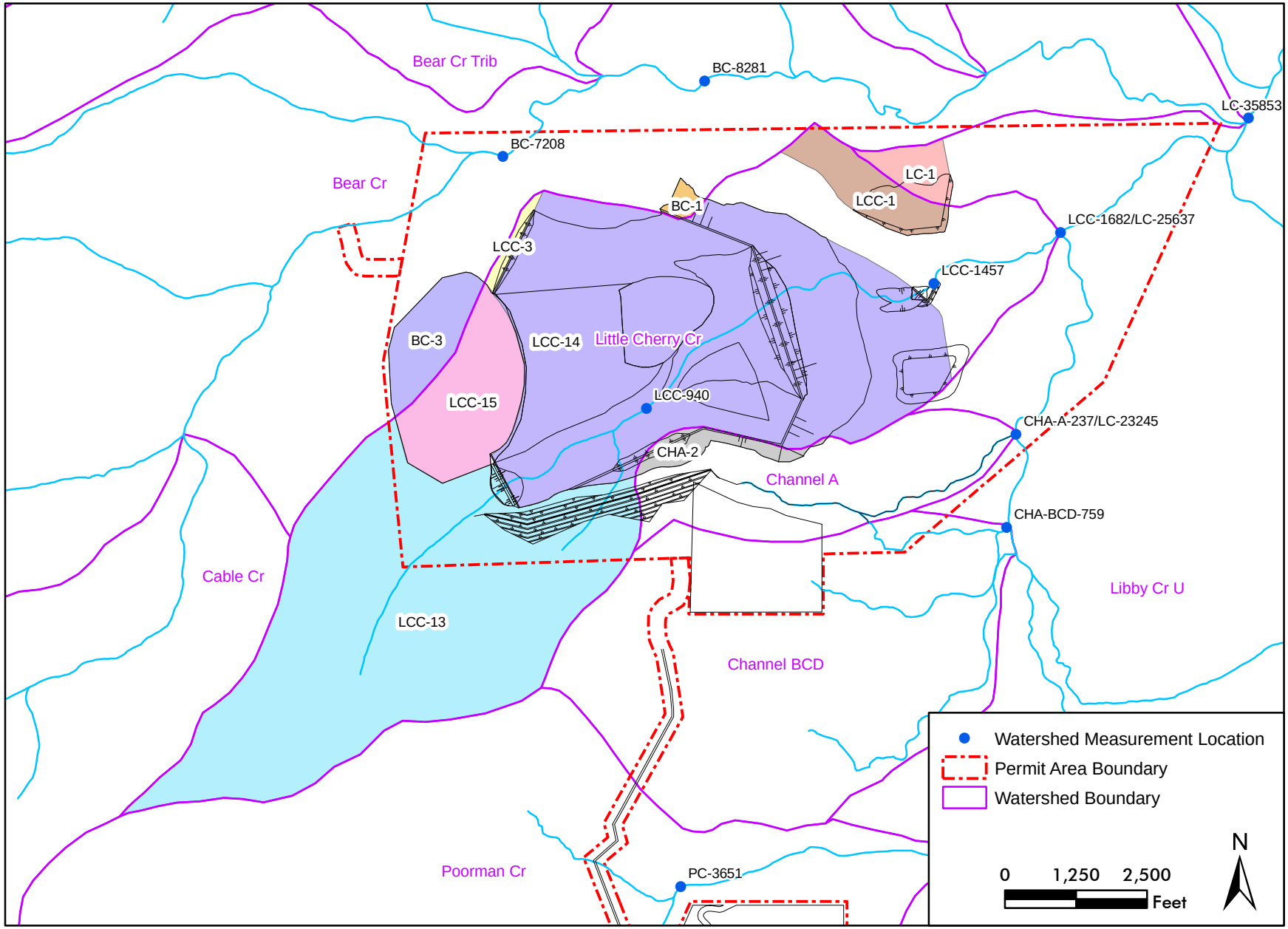


Figure 5. Watershed Analysis, Alternative 4 Operations

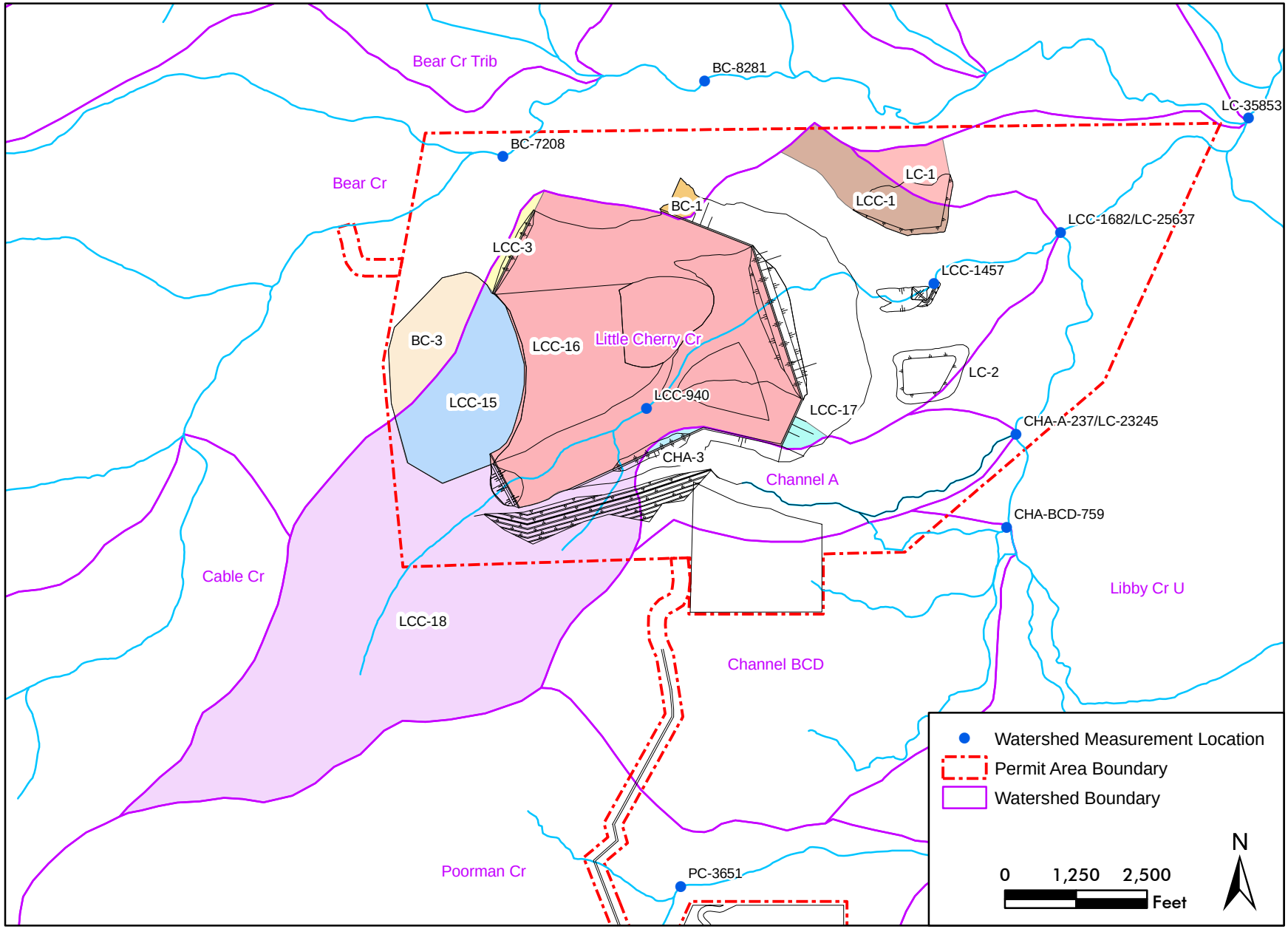


Figure 6. Watershed Analysis, Alternative 4 Closure

Water Yield Discussion for Montanore Mine Alternatives and Transmission Line Alternatives

The Kootenai National Forest Plan contains water yield guidelines based on instream resource values (Guidelines for Calculating Water Yield Increases, Appendix 18, KNF Plan). Because the greatest risk of degrading channel function occurs during high flow periods, it is the increase in magnitude and duration of peakflows that concerns land managers the most. Timber harvest often alters normal streamflow dynamics, particularly the volume of peak flows (maximum volume of water in the stream) and base flows (the volume of water in the stream representing the groundwater contribution). The degree these parameters change depend on the road density, percentage of total tree cover removed from the watershed, and the amount of soil disturbance caused by the harvest, among other things. For example, if harvest activities remove a high percentage of tree cover and cause light soil disturbance and compaction, rain falling on the soil will infiltrate normally. However, due to the loss of tree cover, evapotranspiration (the loss of water by plants to the atmosphere) will be much lower than before. Thus, the combination of normal water infiltration into the soil and decreased uptake of water by tree cover results in higher stream flows. In general, timber harvest on a watershed scale results in water moving more quickly through the watershed (i.e. higher runoff rates, higher peak and base flows) because of decreased soil infiltration and evapotranspiration. The creation of openings in a forested canopy would tend to increase snow deposition (Christner and Harr 1982) and wind speeds (Chamberlin 1982). An increase in wind speeds could increase the rate of snowmelt during cloudy and rainy conditions resulting in greater streamflow (Harr 1981).

Water yield increases due to timber harvest activities are a function of canopy reduction and miles of road constructed. Hydrologic responses to these activities will depend on the natural characteristics of the watershed. They can include: increases in snowpack depth, melting rates, surface runoff, subsurface flow interception and landform energy aspects. As discussed under the streamflow regime section, Rain-on-snow (ROS) events can occur in the project area drainages. Water yield estimates for the project area were determined using the KNF beta version of the Equivalent Clearcut Acres Calculator (ECAC). This process is a GIS interface with management activity databases (Oracle and TSMRS) that allows watershed specialists to model (estimate) the current equivalent clearcut acres (ECA) within a watershed of interest. The model calculates disturbances based on the “ECA” (Equivalent Clearcut Acre) procedure. For example a 100-acre harvest area with 100 percent canopy removal would equate to 100 ECAs; a 100-acre harvest with a 52% crown removal would equate to 44 ECAs. The ECAC model calculates ECA for a specified watershed based on the most recent and most impactive (greatest crown removal) management activities associated with roads, timber harvest, and land conversion. The ECAC model does not model peak flows or sediment production and transport. Watershed specialists must use additional models, indices, measures, monitoring, site-specific data, and professional experience to analyze cumulative watershed effects.

The ECAC Model was not designed to develop estimates of flow. The development of flow estimates from ECAC output generally involves separating watersheds by size class and precipitation regime that had already been run through the R1-WATSED model and comparing their results with the above mentioned ECAC process to look at water yield estimates. This procedure has allowed a more simplified analysis path based on ECAs to generate water yield estimates that have been validated by comparison with the R1-WATSED model output. Regression lines created from R1-WATSED outputs are used to determine the number of ECAs

required to generate a 1% increase in peak flows and also the number of ECAs that recover each year in a watershed. Copies of the regression graphs are included in the project file.

The ECAC Model was designed as a quick-analysis tool to enable watershed professionals to estimate the potential effects of forest management (harvest and roading). The utility of the Model is that it offers a quick and consistent method of providing information on past and proposed management activities. The values generated by the model are used, in concert with other water resource information, to interpret the potential effects to a stream channel as a result of implementing a proposed land management activity. Values generated by the model are not to be considered as an absolute measure against verifiable standards, nor by themselves provide an answer as to the effects of implementing the proposed land management activity. Please see Appendix 8 for a more detailed discussion of the models used in this analysis.

Data for the proposed Montanore Mine build out options and the various transmission line options have been run through the ECAC process and the results are displayed below in Tables H-through 4. In general, none of the transmission line options will result in a measurable increase in peak flows to any of the watersheds. For the mine facilities build out options, (besides Little Cherry Creek – see discussion below) only alternative 2 in the Ramsey Creek watershed approaches an increase in water yield that could be measurable compared to existing conditions. On a cumulative basis, the projected increases in Ramsey and Poorman Creek will also be approaching a measurable level for water yields.

The projected impacts to water yield in Little Cherry Creek are for the unaltered basin. Because the alternatives include the construction of a tailings impoundment in the watershed, the majority of the watershed will captured within the tailings impoundment and the water would used in the milling process for the mine. For this reason, the values shown in Tables 1 and 2 for Little Cherry Creek do not represent what that actual condition would be on the ground. It is assumed that the constructed by-pass stream channel which drains the upper portion of the Little Cherry Creek watershed (which is not impacted by the proposal) will be sized correctly to remain in a stable, functional condition.

Depending on which mine build out option is chosen and which transmission line route option is chosen for the preferred alternative, the total cumulative impact to water yield will need to be added from Tables H-2 and H-3 for the selected watersheds. A review of the potential options shows that the combination of Alternative 2 for mine build out and Alternative B for transmission line route would have the highest probability of resulting in a measurable impact to Ramsey Creek. Not withstanding the previous discussion about impacts to Little Cherry Creek, the remaining options for mine build out and transmission line routes all fall within an acceptable level of cumulative impact to water yields for all reviewed watersheds. As mentioned previously, the cumulative level of water yield will be approaching measurable levels in Ramsey and Poorman Creek but none of the transmission line options access the Poorman drainage so the impacts would not be greater than those displayed in Tables H-1 and H-2.

References

Chamberlin, T.W. 1982. Timber Harvest. In: Meehan, W.R., tech, ed., Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America. USDA, Forest Service, PNFRES, General Technical Report- 136, April.

Christner, J., and R.D. Harr. 1982. Peak Streamflows from the Transient Snow Zone, Western Cascades, Oregon. In: Proceedings of the Western Snow Conference, Reno, Nevada, April 19-23, 1982. Colorado State University, Fort Collins, Colorado.

Harr, R.D. 1981. Some characteristics and consequences of snowmelt during rainfall in western Oregon. J. Hydrol., 53:.277-304

Table H-1. Projected Water Yield Increase by Alternative for Full Mine Operation.

Drainage	Existing		Alt 2		Alt 3		Alt 4	
	ECAs	PFI	ECAs	PFI	ECAs	PFI	ECAs	PFI
Bear	610	4.1	172	1.1	18	0.1	169	1.1
Big Cherry	5,145	3.0	58	.03	58	.03	58	.03
Getner	347	13.3	3	0.1	3	0.1	3	0.1
Little Cherry	387	32.2	1,252	104	328	27.3	1,069	89.1
Poorman	216	5.4	214	5.3	182	4.6	132	3.3
Ramsey	166	3.6	373	8.1	274	5.9	274	5.9
Rock	1,376	3.0	1	0.0	1	0.0	1	0.0
Upper Libby[†]	4,038	3.2	2,014	1.6	805	0.6	1,647	1.3
Libby Total	17,952	3.5	2,072	0.4	863	0.2	1,705	0.3

Note: These values do not include the various transmission line alternatives.
[†]The Upper Libby Creek watershed outlet is the bridge where it is crossed by U.S. 2.

Table H-2. Projected Cumulative Water Yield Increase by Alternative for Full Mine Operation.

Drainage	Alt 2		Alt 3		Alt 4	
	ECAs	PFI	ECAs	PFI	ECAs	PFI
Bear	782	5.2	628	4.2	779	5.2
Big Cherry	5,203	3.0	5,203	3.0	5,203	3.0
Getner	350	13.4	350	13.4	350	13.4
Little Cherry[‡]	1,639	136.2	715	59.5	1,456	121.3
Poorman	430	10.7	398	10.0	348	8.7
Ramsey	539	11.7	440	9.5	440	9.5
Rock	1,377	3.0	1,377	3.0	1,377	3.0
Upper Libby[†]	6,052	4.8	4,843	3.8	5,685	4.5
Libby Total	20,024	3.9	18,815	3.7	19,657	3.8

Note: These values do not include the various transmission line alternatives.
[†]The Upper Libby Creek watershed outlet is the bridge where it is crossed by U.S. 2.
[‡]In all alternatives the majority of the disturbance acres in the Little Cherry Creek watershed would be altered for the construction of the tailings impoundment. These acres would not discharge water to the lower section of Little Cherry Creek. This will result in a much lower PFI (similar to existing) to the lower section of Little Cherry Creek than what is displayed.

Table H-3. Projected Water Yield Increase by Alternative for Transmission Line Construction.

Drainage	Existing		Alt B		Alt C		Alt D		Alt E	
	ECAs	PFI	ECAs	PFI	ECAs	PFI	ECAs	PFI	ECAs	PFI
Howard	117	8.4	16	1.1	20	1.4	59	4.2	59	4.2
Ramsey	166	3.6	24	0.5	0	0	0	0	0	0
Midas	535	13.4	36	0.9	40	1.0	0	0	0	0
Miller	1,253	7.4	104	0.6	135	0.8	141	0.8	9	0.05
Fisher Tribs[‡]	n/a	n/a	89	n/a	120	n/a	120	n/a	84	n/a
West Fisher	2,160	3.1	0	0	0	0	13	.02	193	0.3
Upper Libby[†]	4,038	3.2	87	.07	69	.05	69	.05	69	.05
Fisher Total	53,133	4.1	193	.01	255	.02	274	.02	286	.02

[‡]Fisher River tributaries include Hunter, Sedlak and a face drainage. These areas do not have stream channels with direct connections to the Fisher River. These areas were all combined in the Fisher Total value.

[†]The Upper Libby Creek watershed outlet is the bridge where it is crossed by U.S. 2.

Table H-4. Projected Cumulative Water Yield Increase by Alternative for Transmission Line Construction.

Drainage	Alt B		Alt C		Alt D		Alt E	
	ECAs	PFI	ECAs	PFI	ECAs	PFI	ECAs	PFI
Howard	133	9.5	137	9.8	293	12.6	293	12.6
Ramsey	190	4.1	166	3.6	166	3.6	166	3.6
Midas	571	14.3	575	14.4	535	13.4	535	13.4
Miller	1,357	8.0	1,388	8.2	1,394	8.2	1,262	7.4
West Fisher	2,160	3.1	2,160	3.1	2,173	3.1	2,353	3.4
Upper Libby[†]	4,125	3.3	4,107	3.3	4,107	3.3	4,107	3.3
Fisher Total	53,326	4.1	53,388	4.1	53,407	4.1	53,419	4.1

[†]The Upper Libby Creek watershed outlet is the bridge where it is crossed by U.S. 2.

Appendix I—Visual Simulations



Figure I-1. Visual Simulation of the Little Cherry Creek Impoundment Looking West from the Scenic Overlook on NFS Road #4776



Figure I-2. Visual Simulation of the Poorman Impoundment Looking West from the Scenic Overlook on NFS Road #4776



Figure I-3. Visual Simulation of the Miller Creek or West Fisher Creek Transmission Line Alignments Looking Southeast from Howard Lake

Appendix J— Montanore 230-kV Transmission Line Minimal Impact Standard Assessment

Appendix J
Montanore 230-kV Transmission Line Impact Minimization Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C		Altternative D		Alternative E		Alternatives C, D and E	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
Circular MFSA-2, section 3.2(d)(1)(d)(iii) through (xi)														
i. National wilderness areas	N/A	N/A	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	none	No direct effect on wilderness attributes	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	none	No direct effect on wilderness attributes
ii. National primitive areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
iii. National wildlife refuges and ranges	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
iv. State wildlife management areas and wildlife habitat protection areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
v. National parks and monuments	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
vi. State parks	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
vii. National recreation areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
viii. Designated or eligible national wild and scenic rivers system	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
ix. Roadless areas over 5,000 acres	acres in clearing width/ low, moderate, high effect	Miles of new and high- upgrade roads	2, moderate effect	0.1	none	moderate effect	No effect	No effect	No effect	No effect	No effect	No effect	Avoidance of IRAs	No effect
x. Rugged topography (areas with slopes >30%)	miles of centerline/ low, moderate, high effect	Acres/ low, moderate, high effect	7.4	16.5	none	moderate effect	5.2	2.1	2.9	1.3	3.4	2.1	Helicopter use for vegetation clearing and structure construction adjacent to grizzly bear core habitat to decrease number of access roads	Minor effect
xi. Specially managed buffer areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
Circular MFSA-2, section 3.4(1)(b) through (w)														
b. state or federal waterfowl production areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
c. Designated natural areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect

Appendix J
Montanore 230-kV Transmission Line Impact Minimization Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C		Altternative D		Alternative E		Alternatives C, D and E	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
d. Critical habitat for federal T&E species														
Bull trout	# structures within 1 mile of bull trout critical habitat	acres new and high-upgrade road disturbance within 1 mile of bull trout critical habitat	15	3.5	Implementation of Storm Water Pollution Prevention Plan and structural and nonstructural BMPs. Construction of stream crossings per KNF and DEQ requirements; minimization of disturbance on active floodplains; curtailement of construction activities during heavy rains. Additional measures described under "severe erosion risk" below.	May affect, and likely to adversely affect bull trout critical habitat.	9	0.6	6	0.6	28	1.7	In addition to measures described for Alternative B: re-routing to avoid highly erosive soils; use of H-frame poles, allowing longer spans and fewer structures and access roads; helicopter construction in grizzly bear core habitat to decrease number of access roads; placement of NFS road #4725 into long-term intermittent stored status; where feasible, location of structures outside of riparian areas; new culverts to allow fish passage; stream-crossing structures designed to withstand a 100-year flow event; completion of habitat inventory and development of instream structures in Libby Creek. Additional measures described under "severe erosion risk" below.	May affect, and likely to adversely affect bull trout critical habitat.
e. Seasonally occupied habitat for federal and state T&E species														
grizzly bear habitat physically removed	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	32	N/A	Protection of grizzly bear habitat through acquisition of or conservation easements on 2,826 acres of non-Forest System lands. Closure of NFS road #4724 from April 1 to June 30.	May affect, and likely to adversely affect grizzly bear	11	N/A	12	N/A	13	N/A	Protection of grizzly bear habitat through acquisition of or conservation easements on 24 to 28 acres of habitat on non-Forest System lands. Habitat enhancement for temporary displacement effects. Creation of grizzly bear core habitat through yearlong access changes through the installation of barriers or gates in several roads.	May affect, and likely to adversely affect grizzly bear
Temporary displacement effects on grizzly bears due to helicopter use	acres in influence zone	N/A - all roads included in heli. const. influence zone	14,901	N/A	Same as above	May affect, and likely to adversely affect grizzly bear	12,582	N/A	13,586	N/A	16,501	N/A	Same as above	May affect, and likely to adversely affect grizzly bear
clearing of lynx overall habitat	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	117	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx	79	N/A	108	N/A	193	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx
clearing of lynx denning habitat	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	31	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx	19	N/A	19	N/A	24	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx
occupied bull trout habitat	acres in clearing width and width of new and high-upgrade roads in watersheds with occupied bull trout habitat	Included in clearing width impacts	181	N/A	Same as bull trout critical habitat above.	May affect, and likely to adversely affect bull trout	111	N/A	84	N/A	179	N/A	Same as bull trout critical habitat above.	May affect, and likely to adversely affect bull trout
f. National historic landmarks, districts, or sites	# of sites	Included in transmission line analysis buffer	0	N/A	N/A	No effect	0	N/A	0	N/A	0	N/A	N/A	No effect

Appendix J
Montanore 230-kV Transmission Line Impact Minimization Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C		Altternative D		Alternative E		Alternatives C, D and E	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
g. Eligible historic landmarks, districts, or sites	# of sites	Included in transmission line analysis buffer	4	N/A	Review and consultation with the SHPO to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary prior to SHPO consultation.	Because there would be no direct effects, a determination of no adverse effect may be achieved through SHPO consultation.	3	N/A	3	N/A	3	N/A	Review and consultation with the SHPO to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary prior to SHPO consultation.	Because there would be no direct effects, a determination of no adverse effect may be achieved through SHPO consultation.
h. Municipal watersheds	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
i. FWP Class I or II streams or rivers	acres in clearing width within watershed of affected streams	Acres of roads within watershed of affected streams	106.9	7	Same as described above for "occupied bull trout habitat" and below for "severe erosion risk".	Minor increases in sediment	72.2	0.3	46.7	0.3	46.7	0.3	Same as described above for "occupied bull trout habitat" and below for "severe erosion risk".	Minor effects
j. 303(d) listed impaired streams	acres in clearing width within watershed of affected streams	Acres of roads within watershed of affected streams	94.7	3.5	Same as described above for "occupied bull trout habitat"and below for "severe erosion risk".	Minor increases in sediment	67.5	0.6	67.8	0.6	29.1	0.3	Same as described above for "occupied bull trout habitat"and below for "severe erosion risk".	Minor effects
k. Highly erodible soils/reclamation constraints														
Severe erosion risk	miles of centerline	Acres of roads	6.7	8.9	Erosion and sediment control BMPs; interim reclamation (replacing soil where it was removed and reseeding) of access roads ; immediate stabilization of cut-and-fill slopes; seeding, application of fertilizer, and stabilization of road cut-and-fill slopes and other disturbances along roads as soon as final grades post-construction grades are achieved; at the end of operations, decommissioning of new roads and reclamation of most other currently existing roads to pre-operational conditions; ripping of compacted soils prior to soil placement, and disking and harrowing of seedbeds.	Minor losses of soil until re-establishment of vegetation.	3.7	4.2	5.2	4.2	3.7	3.1	In addition to measures described for Alternative B: development and implementation of a Road Management Plan; where feasible, soil salvage in 2 lifts; after removal of transmission line, soil salvage before reclamation of decomissioned roads. Additional measures described above for "bull trout occupied habitat".	Minor losses of soil until re-establishment of vegetation.
High sediment delivery	miles of centerline	Acres of roads	5.1	6.3	Same as for erosion risk above	Minor contributions of sediment until re-establishment of vegetation	1.1	1.5	1.1	1.5	0.4	0.5	Same as for erosion risk above	Minor contributions of sediment until re-establishment of vegetation
l. Compatibility with visual management plans/regulations														
Compatibility with visual management plans	Yes/No	Yes/No	Yes	Yes	Forest Plan amendment	In compliance	Yes	Yes	Yes	Yes	Yes	Yes	Forest Plan amendment	In compliance
Indirect visual impacts to the CMW	Acres within CWA from which transmission line can be seen	N/A	1,501	N/A	none	No effect on wilderness attributes	1,426	N/A	1,,233	N/A	1,177	N/A	none	No effect on wilderness attributes

Appendix J
Montanore 230-kV Transmission Line Impact Minimization Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C		Altternative D		Alternative E		Alternatives C, D and E	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
m. Winter habitat for elk, deer, moose, pronghorn, or bighorn sheep														
elk	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	123	N/A	Potential benefits to elk from land acquisitions and road access changes for grizzly bear and big game mitigation. As described in the Environmental Specifications, transmission line construction and associated motorized travel would be prohibited from December 1 to April 30. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if MMC can clearly demonstrate that no significant environmental impacts will occur as a result.	Minor effects	174	N/A	149	N/A	93	N/A	Potential benefits to elk from land acquisitions and road access changes for grizzly bear and big game mitigation. As described in the Environmental Specifications, transmission line construction and associated motorized travel would be prohibited from December 1 to April 30. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if MMC can clearly demonstrate that no significant environmental impacts will occur as a result.	Minor effects
white-tailed deer	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	149	N/A	Same as described above for elk	Minor effects	191	N/A	208	N/A	179	N/A	Same as described above for elk	Minor effects
moose	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	146	N/A	Same as described above for elk	Minor effects	165	N/A	168	N/A	210	N/A	Same as described above for elk	Minor effects
n. Elk security areas	Acres of security habitat in clearing width	Included in clearing width impacts	84	N/A	Security habitat maybe created through additional road access changes that may occur on land acquired as part of the grizzly bear mitigation.	Minor effects	48.7	N/A	No effect	N/A	No effect	N/A	Creation of security habitat through yearlong access changes through the installation of barriers or gates in several National Forest System roads. Additional security habitat may also be created through additional road access changes that may occur on land acquired as part of the grizzly bear mitigation.	Minor effects
o. Occupied mountain goat habitat														
habitat physically impacted	acres in clearing width	Included in clearing width impacts	47	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects	0	N/A	0	N/A	0	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects
construction displacement effects	acres in 1-mile helicopter influence zone	N/A - all roads included in heli. const. influence zone	3,877	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects	624	N/A	729	N/A	729	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects
p. Sage and sharp-tailed grouse breeding areas and winter range	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
q. High waterfowl population areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
r. Areas of unusual scientific, educational, or recreational signficance	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect

Appendix J
Montanore 230-kV Transmission Line Impact Minimization Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C		Altternative D		Alternative E		Alternatives C, D and E	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
s. Areas with high probability of including significant paleontological resources	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
t. Sites with religious or heritage significance/value to Indians	# sites	#sites	No sites identified	No sites identified	Ongoing tribal consultation	To be determined during consultation	No sites identified	No sites identified	No sites identified	No sites identified	No sites identified	No sites identified	Ongoing tribal consultation	To be determined during consultation
u. Water bodies	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
v. Potable surface water supplies	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
w. Active faults (for substation)	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect