Klohn Crippen Berger

March 6, 2009

Mines Management Inc.
c/o Klepfer Mining Services
13058 Sherwood Ct.
Hayden Lake, ID
83835

**Eric Klepfer**

Dear Mr. Klepfer:

**Montanore Project – A Silver and Copper Mine**
**Risk Assessment**

Please find attached the Risk Assessment Report for the proposed Montanore Silver and Copper Project. The Risk Assessment is the product of a workshop held with regulatory agencies and consultants to assess the potential risks to the environment of the mine development. The Risk Assessment identifies no major "high" level risk items, although there are numerous "lower" level risk items which will require a risk management plan as part of the design, operation and closure of the facilities. A risk management plan is presented to provide guidance for minimizing and managing the risks and to compensate for risk items if they were to occur.

Thank you for the opportunity to work with you on this interesting project and we look forward to your future development of the project.

Yours truly,

**KLOHN CRIPPEN BERGER LTD.**

Harvey McLeod, P.Eng.(BC), P.Geo.(BC)
Project Manager

090306R-Montanore Tailings Facility Risk Assessment
M09244A02.02.500

# EXECUTIVE SUMMARY

This report presents the results of a risk assessment carried out for the proposed Montanore Silver Copper Project, located near Libby, Montana. Facilities for the proposed underground mine development include: approximately 3 miles of underground adits; up to 20,000 tpd processing plant and a land area disposal of excess water; 300 ft high cycloned sand tailings dam with associated tailings and water reclaim pumping and piping systems; access roads; transmission line; electrical substation; and concentrate loadout facility at Libby.

The risk assessment was conducted using the failure modes effects analysis (FMEA) methodology. Risk is the product of the likelihood of an event occurring times the consequence of that event. The risk assessment was carried out in a workshop format with the EIS team, and mine consultants, with follow-up teleconference calls and reviews of this report.

The methodology of the FMEA consists of identifying potential failure modes and the effect of the event on the environment. The probability or likelihood of the event is quantified on a 5 level scale (A to E) based on the annual probability of occurrence. The consequence of the event is quantified on a 5 level scale (1 to 5) for key environmental consequences, which include: water quality, biophysical, community/social, and cost. The methodology also accounts for increased risk due to the level of confidence and due to longer exposure times for post closure risk.

Risk management plans and compensating factors are identified to minimize and manage the risk and to identify response plans in the event of a risk item occurring. The risk assessment was also used to compare alternative plant site locations, tailing facilities and transmission line routes.

The main conclusions of the risk assessment and the main risks identified are summarized as follows:

**Construction and Operations Risks**

- Plant site

  The main risks are associated with forest fires and equipment/operator failures that could lead to a release of reagents, tailings or chemicals. Fire awareness and fire prevention training will be part of the Environmental Health and Safety Plan (EHSP) for the mine. A spill management and spill response plan will also be part of the EHSP.

  Alternative plant site locations at Libby Creek or Ramsey Creek had similar risk profiles, except for an overland conveyor for the Libby Creek alternative that posed a low level risk of an ore spill.

- Underground Mine

  The main risks are associated with potential loss of life due to accidents and rock falls. Accident prevention and safety training will be part of the EHSP. Rock falls and ground control will be managed with geotechnical design and monitoring. There is a risk that the mine development could modify the groundwater regime in the wilderness area and although the likelihood of this occurring is very low, the importance of the wilderness area increases the risk. Monitoring of the wilderness lake levels will be carried out as a potential indicator of the influence of the mine.

- Tailings Facility

  Two alternative locations for tailings storage were assessed: Little Cherry Creek and Poorman Creek. The main risks associated with both facilities include the potential for loose, pervious soils in the dam foundations or impoundment areas. Loose soils in the dam foundation area could reduce the dam stability, although this will be mitigated with additional detailed drilling and a conservative dam design. The potential for pervious soil connections from the impoundment area to either underground aquifers or potentially surface water is a risk which will be managed with a groundwater monitoring program and installation of a pump back system if required.

The Poorman Creek alternative has additional risks associated with the immediate vicinity of a local landowner at the toe of the dam, which could lead to social and legal implications that could require development of a new site. This alternative also uses a more complex system of thickening and tailings distribution that increases the associated risk of mechanical upsets and human errors during operations.

- Roads, Pipelines, Transmission Lines, Substation and Concentrate Loadout

  The main risks are associated with accidents, spills, forest fires and vandalism. There are no highly toxic materials and spills will be managed as part of the EHSP, as will safety and forest fire response. There is a low risk of a vehicle or helicopter accident with a threatened and endangered species.

  Three transmission line locations were assessed; the risk profiles for the alternatives are similar.

- Land Application Disposal Areas (LAD's)

  The main risks are associated with the potential for the area to not be able to accept all of the solutions, either due to: preferential flow paths; low permeability soil; or to operator errors and ditch failures. The operation will be managed with the EHSP and the performance of the LAD's will be monitored. Alternative LAD's may be required to offset any reduction in expected capacity.

## Closure Risks

Upon closure, the plant site, pipelines, and associated infrastructure will be decommissioned and the disturbed areas reclaimed. The underground mine will be plugged with concrete/soil plug, which will facilitate re-establishment of the pre-mining groundwater regime, as well as saturating the mine opening and further reducing any risk of long term acid rock drainage. The tailings facility will be closed as a "dry" facility and revegetated. The dam will drain, thereby improving the long term factor of safety.

The main risks associated with closure include:

- Underground Mine

  The main risks are associated with the potential for changes in the water quality of seeps and potential failure of the portal plug. The portal plug will require a robust design for long term performance. Water quality will be monitored during operations and post-closure, which will further quantify any potential for water quality effects.

- Tailings Storage Facility

  The dam safety risks reduce with time as the TSF drains and the main risks are associated with water quality effects on the groundwater and/or surface waters. Water quality will be monitored during operations and post-closure, which will further quantify any potential for water quality effects.

This risk assessment report should be used to guide the environmental health and safety plans (EHSP), the operations, maintenance and surveillance procedures (OMS) and the emergency preparedness and response plans (EPRP) for operation of the facility. A risk register should be prepared prior to construction and operations that identifies a person responsible for management of each of the Level 1, 2 and 3 risk items, along with an appropriately developed risk management plan, monitoring and annual reporting of the risks. The risk assessment should also be updated throughout operations to reflect ongoing changes and optimization of risk management plans.

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Appendix I Risk Assessment Worksheets and Risk Charts

# 1. INTRODUCTION

## 1.1 General

This report presents the results of a risk assessment carried out for the Montanore Project in March 2008. The risk assessment utilized the Failure Modes Effects Analysis (FMEA) methodology, which has been developed for use on mining projects (McLeod & Plewes, 1999) and the methodology is described in this report. The Montanore Project is a proposed 12,000 to 20,000 tpd underground silver copper mine located just south of Libby, Montana. The EIS team is preparing an Environmental Impact Statement (EIS) and the risk assessment is to be incorporated into the EIS document. The risk assessment was facilitated by Mr. Eric Klepfer of Klepfer Mining Services and Mr. Harvey McLeod of Klohn Crippen Berger Ltd. (KCBL) and was attended by the government agencies involved with the preparation of the EIS, as well as the EIS Contractor, ERO Resources Corporation.

The objectives of the risk assessment are summarized as follows:

- Create a "brainstorming" environment to facilitate identification of "anything that could go wrong" with the project or "anything that might affect something else". These are referred to as the failure modes.
- Systematically quantify the likelihood of each potential event occurring and the potential consequences of that event happening. The likelihood and consequence are quantified on a 5 level scale.
- Use the assessment to: 1) compare risks of alternatives to guide in the selection of the lower risk components for the project design; and 2) identify mitigating factors that could reduce the risk.
- Rank all risks and develop risk management plans for the higher level risks.

# 2. PROJECT DESCRIPTION AND PROJECT ALTERNATIVES

The general arrangement of the mine and the main associated facilities are shown in Figure 2.1. The main project components are summarized as follows, and described in the following subsections.

**Project Components**

- Underground Mine Workings
- Plant Site
  - Ramsey Creek Plant Site Alternative
  - Libby Creek Plant Site Alternative
- Tailings Storage Facility
  - Little Cherry Creek Alternative
  - Poorman Creek Alternative
- Infrastructure
  - Access Road (Alternatives 2 and B)
  - Transmission Lines (Alternatives C, D and E)
  - Electrical Substation
  - Concentrate Loadout Facility (in Libby)
  - Land Application Disposal Areas (LAD)

The FMEA was carried out for each of the main project components and alternatives.

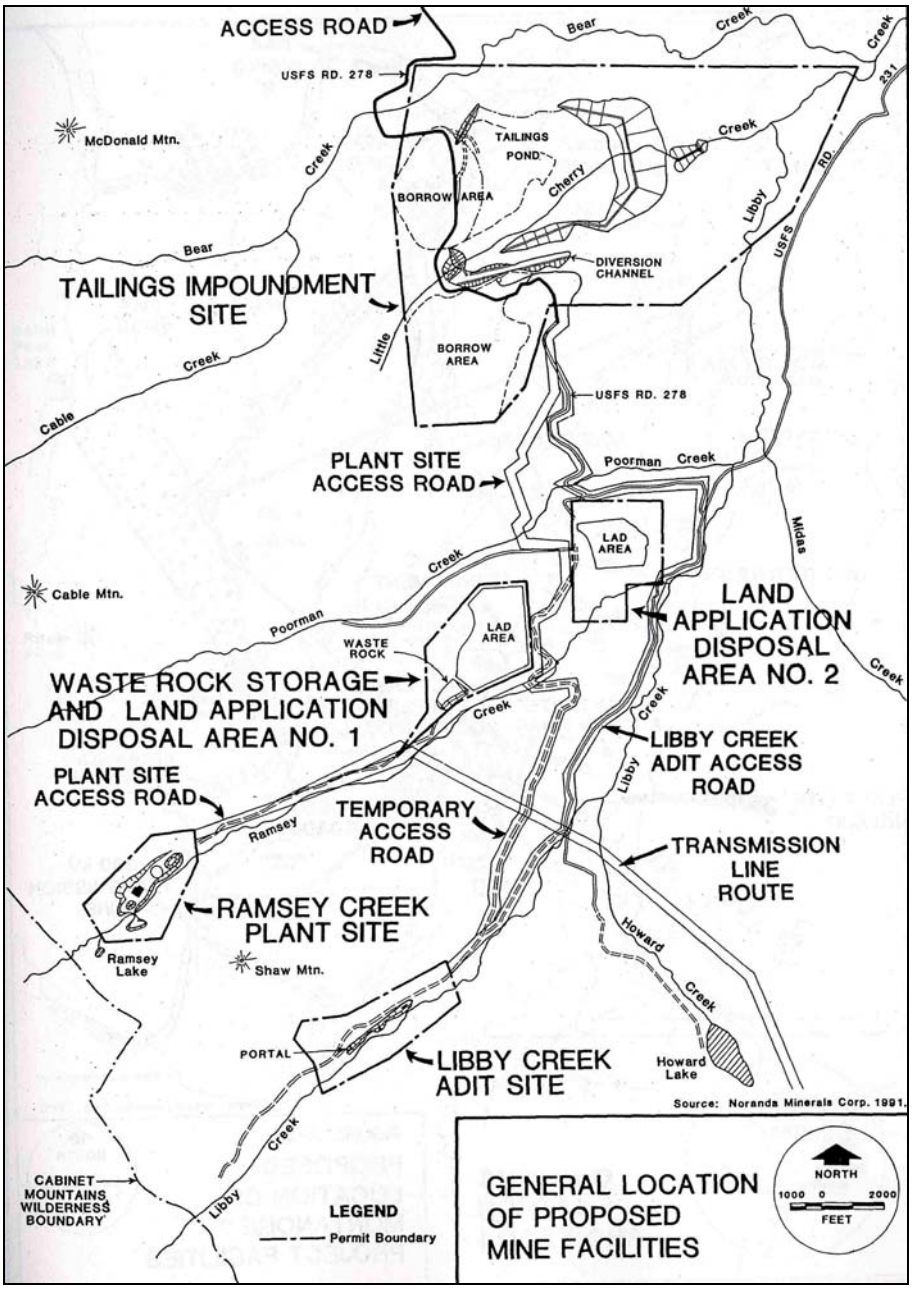


**Figure 2.1 General Arrangement - Mine and Associated Facilities**

## 2.1 Mine and Plant Site

There are two alternatives for location of the main plant site and the main access adit to the underground workings: Ramsey Creek Plant Site (Figure 2.3) and the Libby Creek Plant Site (Figure 2.4). The underground mine workings will extend approximately 3 miles southwest beneath the Cabinet Mountains Wilderness area. The mine workings (Libby Decline) are up to 3,000 feet below the ground surface. A generalized cross section is shown in Figure 2.2.

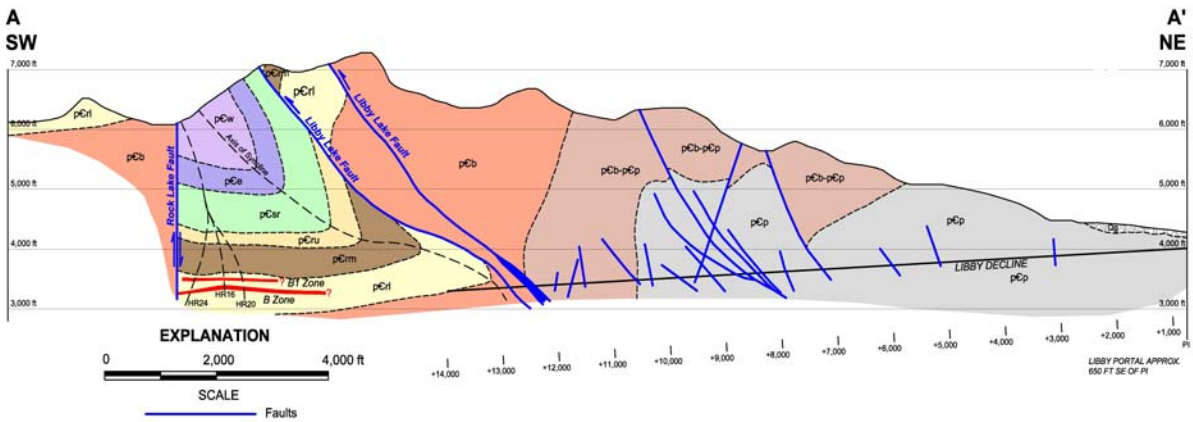


**Figure 2.2 Cross Section Showing Main Libby Access Decline**

The plant site facilities will be able to process up to 20,000 tpd and will include: a grinding circuit, coarse ore stockpiles, ore processing equipment (flotation circuits, thickeners, dryers, shop/warehouse facilities, offices and ore storage areas. Storage of potentially dangerous goods include: hydrocarbons, mill reagents, and explosives.

The main potential risks with the underground workings include: 1) geochemistry and risk of neutral metal leaching or acid rock drainage; 2) collapse of mine working; 3) equipment accidents; and 4) excessive mine groundwater inflows.

On closure the plant site will be decommissioned and the area reclaimed. The underground mine workings will be sealed with a portal plug. The main potential concerns relate to: 1) long term geochemistry; and 2) ground failure or portal plug failure or groundwater changes.

The only significant difference, with respect to the main components, between the Ramsey Creek and Libby Creek options is that the Libby Creek option will require an ore conveyor across Libby Creek, from the adit to the plant site.

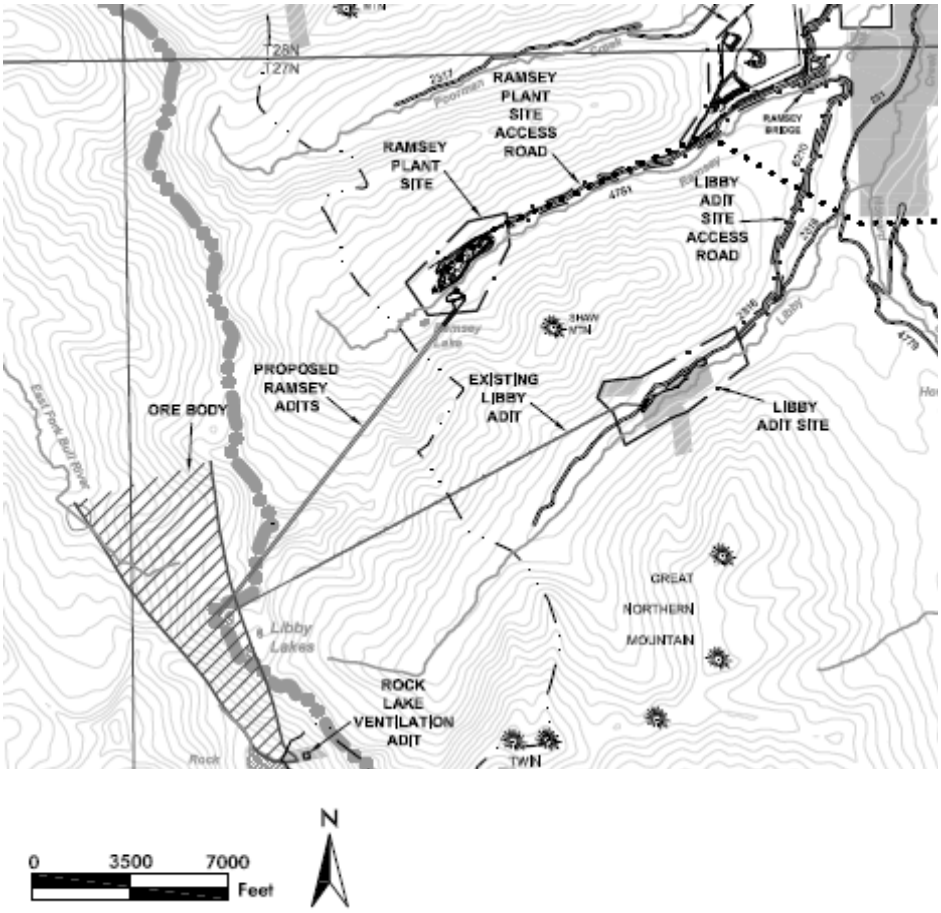


**Figure 2.3 Ramsey Creek Plant Site Alternative**

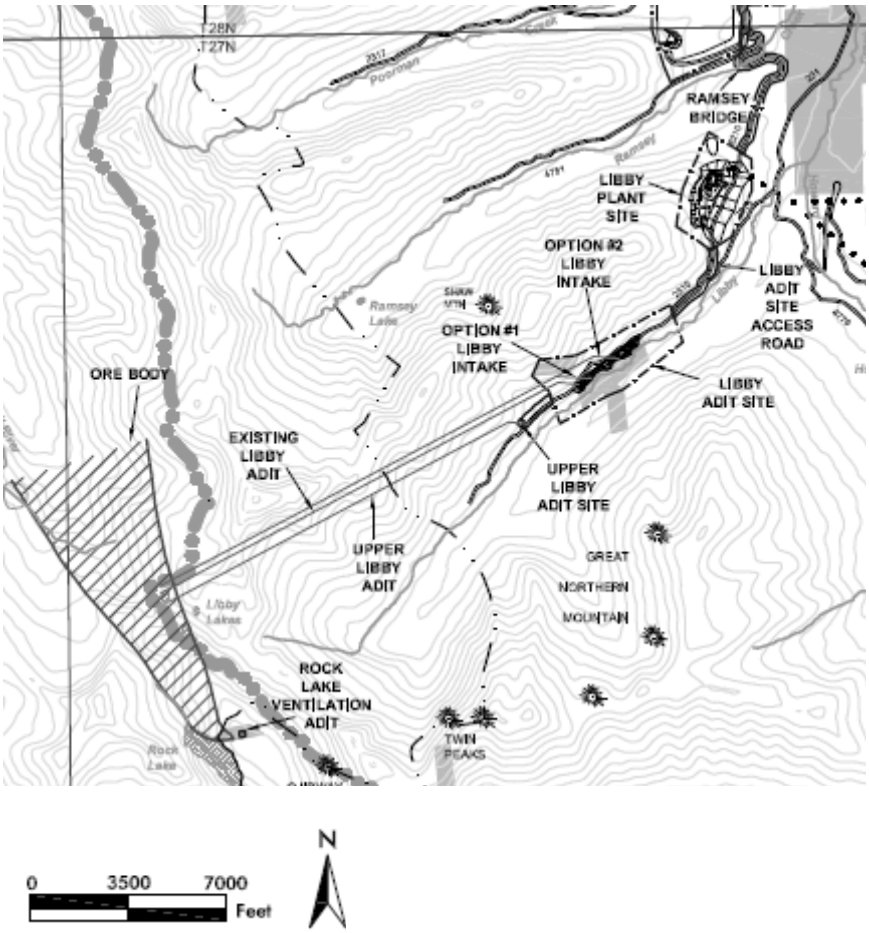


**Figure 2.4 Libby Creek Plant Site Alternative**

### 2.1.1 Land Application Disposal Areas

Land application disposal areas (LAD's) will be used to dispose of excess water from the underground mine and the locations are shown in plan in Figure 2.1. The water will be distributed with a series of irrigation pipes across the LAD area. Portions of the areas will also be used to store topsoil for reclamation and waste rock from the mining operations.

## 2.2 Tailings Storage Facility

Two alternatives sites have been identified for storage of up to 120 million tons of mine tailings: 1) Little Cherry Creek; and 2) Poorman Creek. The two alternatives are near each other and are shown in Figure 2.5 and Figure 2.6, respectively.

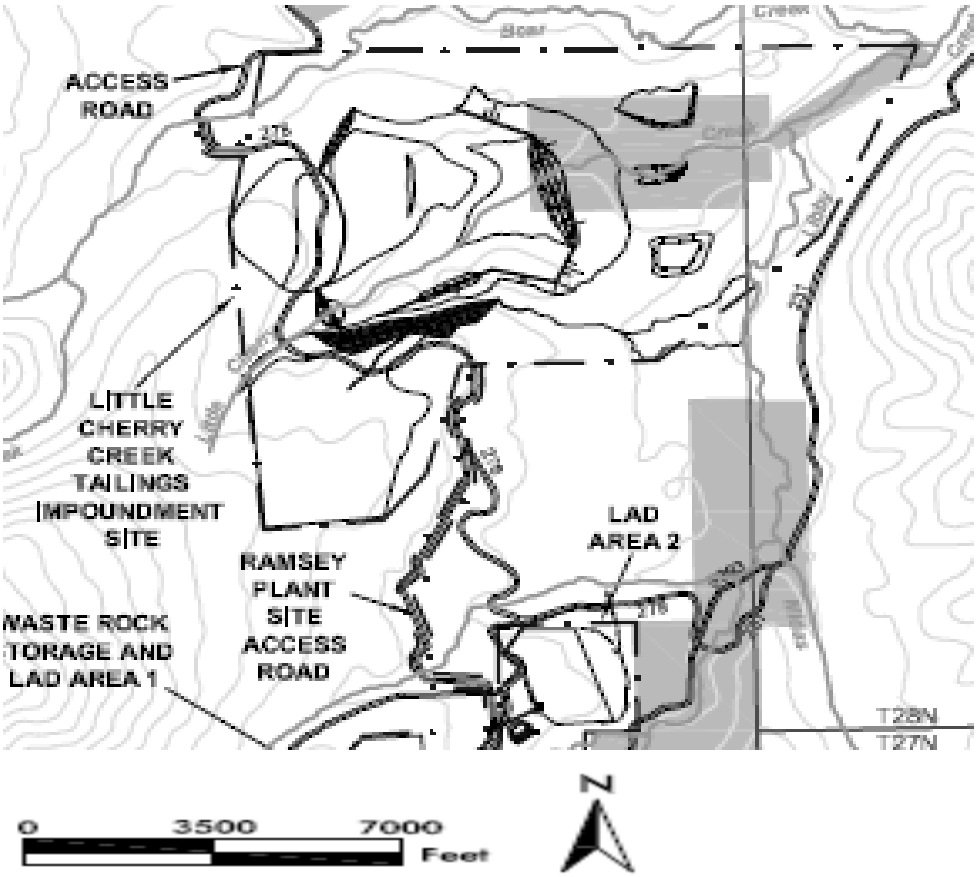


**Figure 2.5 Little Cherry Creek Tailings Impoundment Alternative**

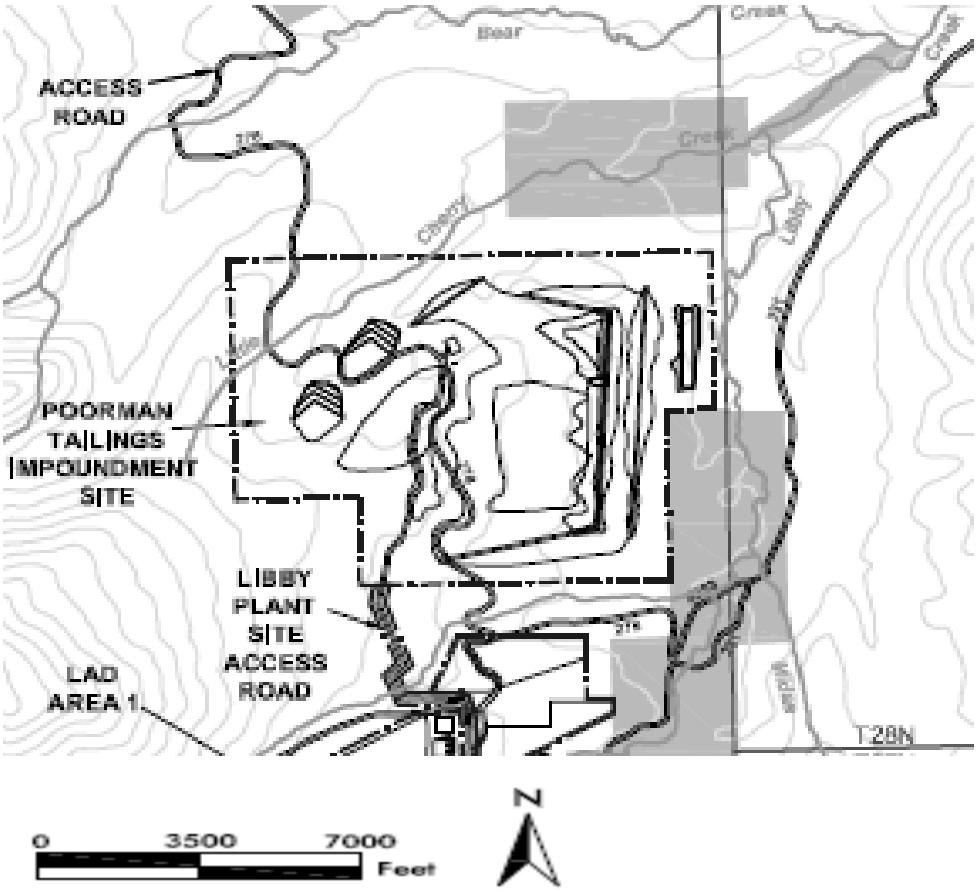


**Figure 2.6 Poorman Tailings Impoundment Alternative**

The Little Cherry Creek alternative has the following main components:

- The Main Dam is designed with an earthfill Starter dam, which will be raised up to 300 ft with the centerline construction method, placing compacted cycloned sand in the downstream shell and a spigotted tailings beach on the upstream side;
- A Starter Dam, approximately 120 ft high, will be constructed across the Little Cherry Creek valley. The dam is designed to contain water up to a height of approximately 60 ft, with an HDPE geomembrane liner, to provide process water for startup of operations and to allow 1 month for commissioning of the facility;

- An underdrainage system will be constructed above the elevation of the initial water storage dam to provide seepage and drainage control for the tailings. The system will include lateral and trunk drains, under both the tailings and cycloned sand dam;

- A seepage collection dam will be constructed downstream of the Main dam, which will collect excess cyclone water, underdrainage water, and seepage, to recycle back to the plant site. Groundwater monitoring wells and flow measurement weirs will be installed;

- The tailings processing and delivery system will consist of a primary cyclone station and high rate thickener at the plant site. The cyclone underflow will be transported by gravity flow in a pipeline to the dam for secondary cycloning to produce sand for dam construction; and

- The dam will be raised over the life of the mine using cycloned sand. The underdrainage and dam drainage systems will be extended, as required. Two earthfill saddle dams will be constructed on the northwest and south sides of the impoundment. The Diversion Dam will also be raised, as required. Tailings overflow (fines) will be selectively spigotted to maintain a reclaim water pond and to manage the geometry of the deposited tailings.

The Poorman Creek alternative has the following main components:

- The impoundment is located on a small intermittent drainage channel, and formed with a U-shaped dam constructed of compacted cyclone sand, with a rockfill toe berm;

- The alternative includes the additional requirement to use high density thickeners for the secondary cyclone overflow and the millsite thickener underflow. Other components of the design, including seepage control, under drainage, and geotechnical design are similar to the Little Cherry Creek alternative. Thickening is proposed to be carried out with a High Compression Thickener (HCT) or Deep Tank Thickener (DTT), which are reasonably common in the industry; and

- During the summer months, the secondary cyclone overflow will need to be piped to a booster pump station located on the left abutment of the dam and pumped uphill to the Paste Plant.

Both alternatives require a main tailings dam up to 300 ft high, constructed mainly with cycloned sand produced from the mine tailings. The dams will be constructed with an earthfill/rockfill starter dam and raised annually to provide storage. Filters and drains are provided for dam stability and drainage.

On closure, the tailings facility will be closed as a "dry" pile and long term concerns are mainly related to erosion and the potential for neutral metal leaching or acid rock drainage.

Some of the main differences between the two alternatives include the following:

- The Poorman Creek alternative has a smaller uphill catchment area and potentially disturbs less wetland;
- The Poorman Creek alternative is immediately adjacent to private land and there is a concern that both visual and groundwater effects may result in the alternative ultimately not being available for tailings storage; and
- The Poorman Creek alternative requires the use of more complicated processing and dewatering facilities for the tailings to maximize the available storage. The alternative included high density thickening of both total tailings and cyclone overflow tailings.

## 2.3 Infrastructure

### 2.3.1 Access Roads and Utility Pipeline Corridors

The access roads will include a combination of existing public access roads and new or temporary construction roads constructed in the areas of the mine and transmission access route. The extent of the roads is shown in Figure 2.7 and Figure 2.8.

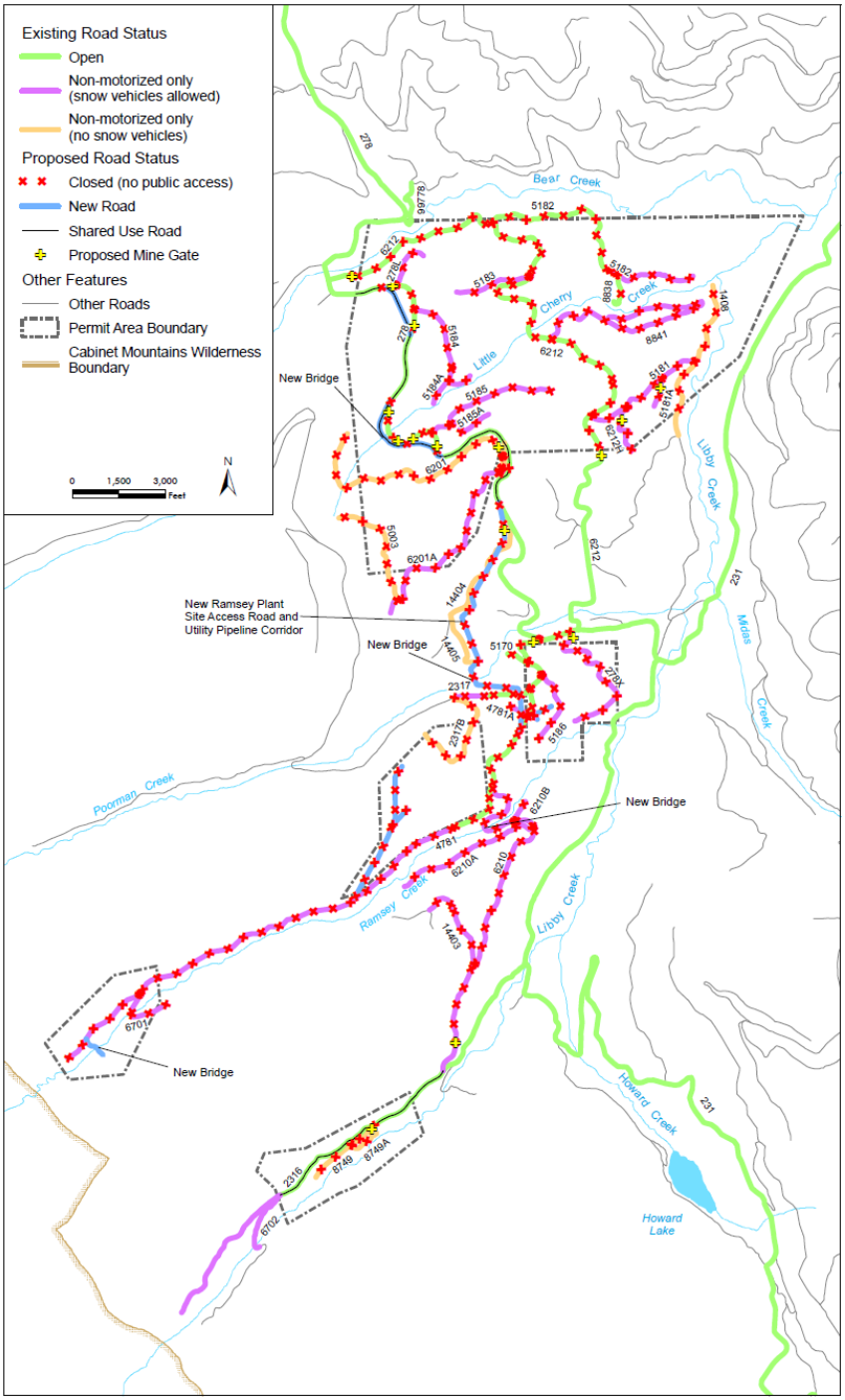


**Figure 2.7 Roads Proposed for Use in Alternative 2**

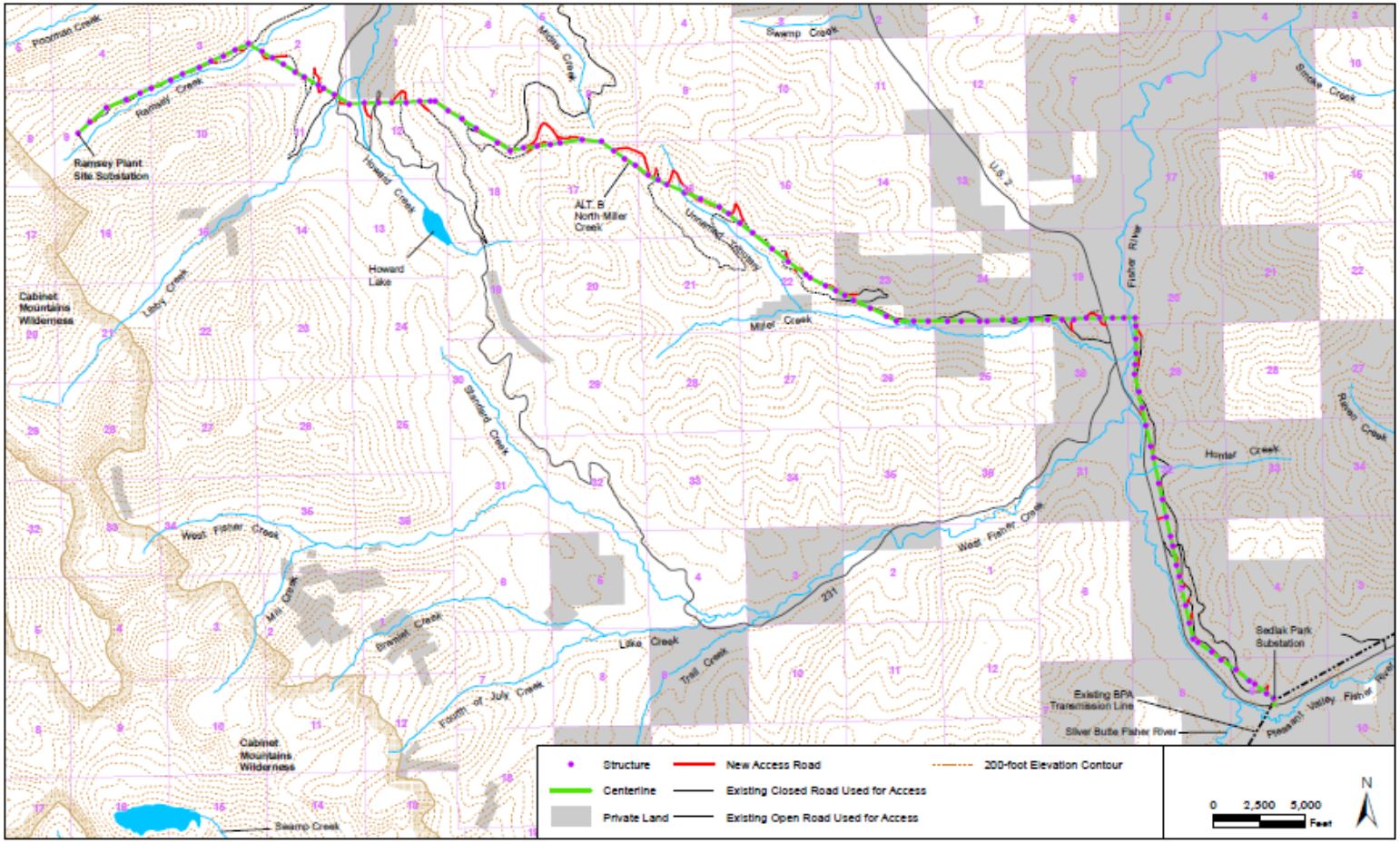


**Figure 2.8 North Miller Creek Alignment, Structures and Access Roads, Alternative B**

### 2.3.2 Transmission Lines and Substation

Three transmission line alternatives, North Miller Creek, Modified North Miller Creek and the West Fisher Creek, have been assessed. These are shown in Figure 2.9. The transmission line components would be the same for the three options and have been divided into construction items and operating items. A common electrical substation, Sedlak Park Substation, would be used and this is shown in Figure 2.9 and Figure 2.10. On closure the lines and substation would be decommissioned.

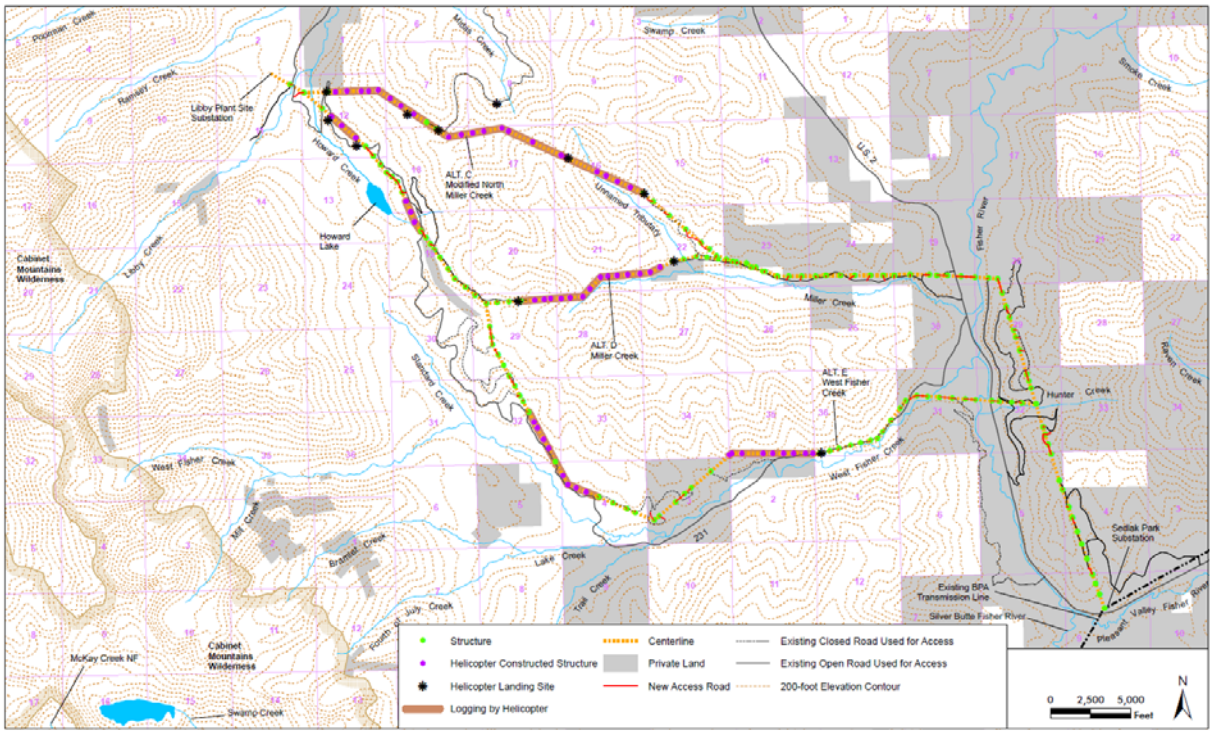


**Figure 2.9 Transmission Line Alternatives**

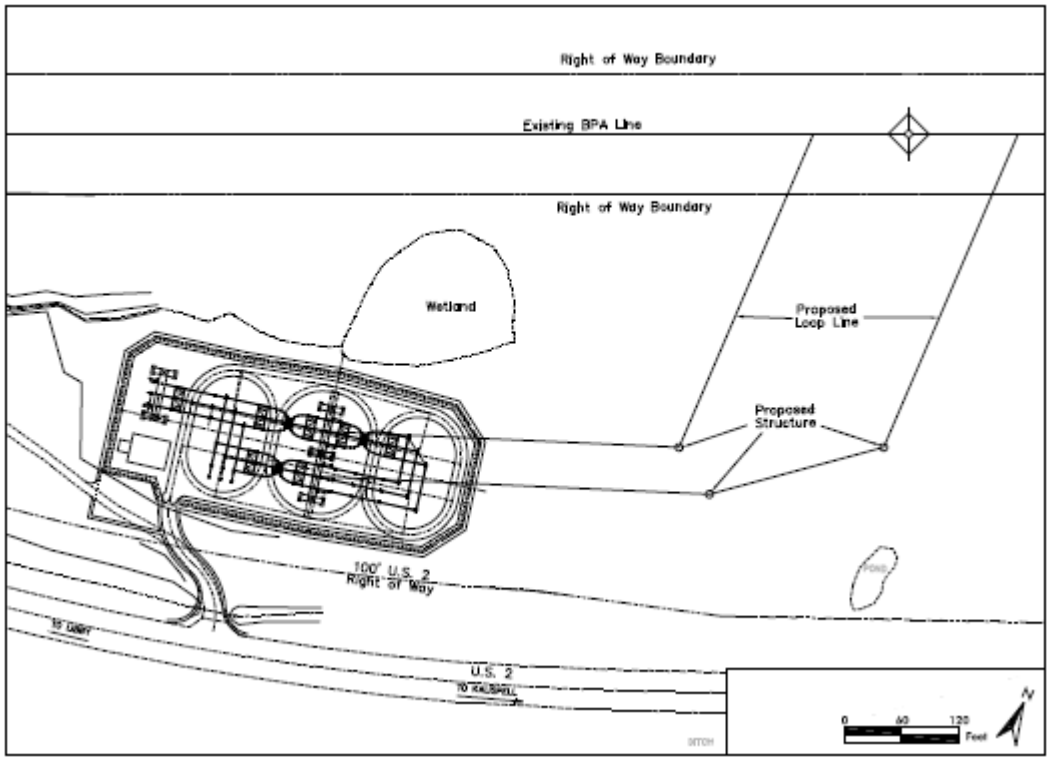


**Figure 2.10 Sedlak Park Electrical Substation**

### 2.3.3 Concentrate Loadout Facility

The concentrate (processed ore) load out facility is located in Libby and consists of concentrate storage bins and a facility for loading concentrate into rail cars for shipping, and this is shown in Figure 2.11.

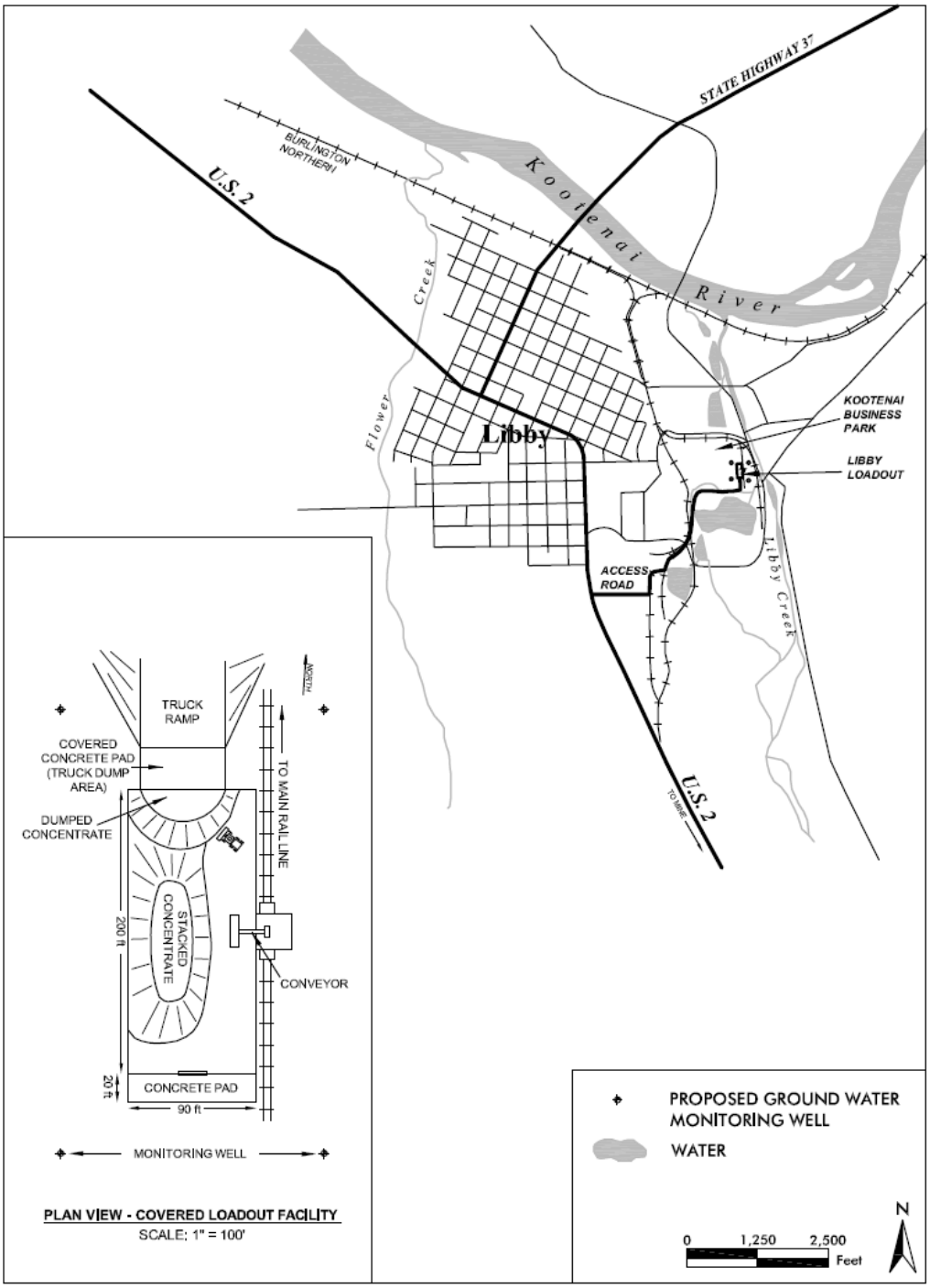


**Figure 2.11 Libby Concentrate Loadout Facility**

# 3. FMEA METHODOLOGY

## 3.1 General

The Failure Modes Effects Analysis (FMEA) considered the elements of the proposed mine and associated facilities as presented in Section 2, of this report. Operating and site conditions were inferred from design reports and from discussion in the workshop. Although there are expected to be additional smaller risks, the workshop concentrated on the main risks that could influence the overall safety and environmental effects of the project. The general risk assessment process is presented in Figure 3.1 and the components, based on the project description are presented in Figure 3.2.

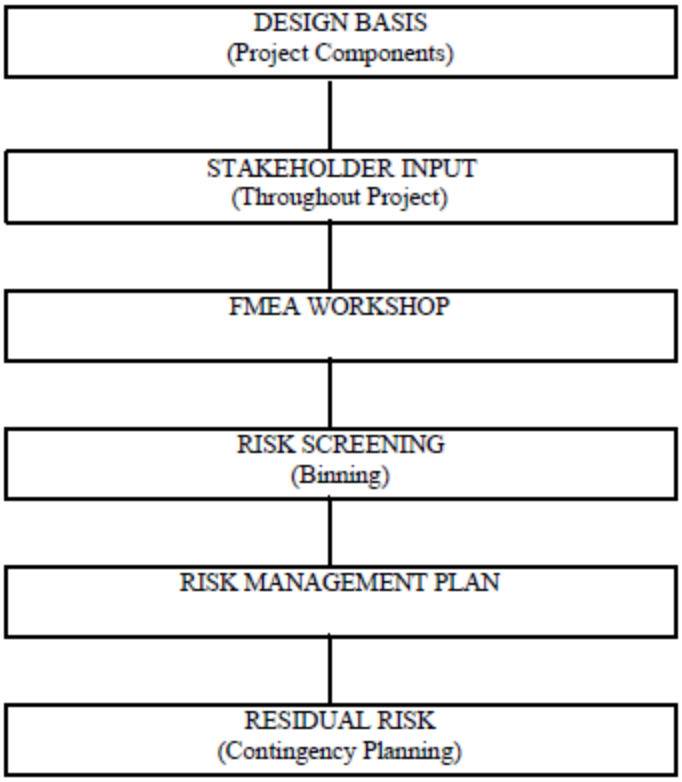


**Figure 3.1 Risk Assessment Process**

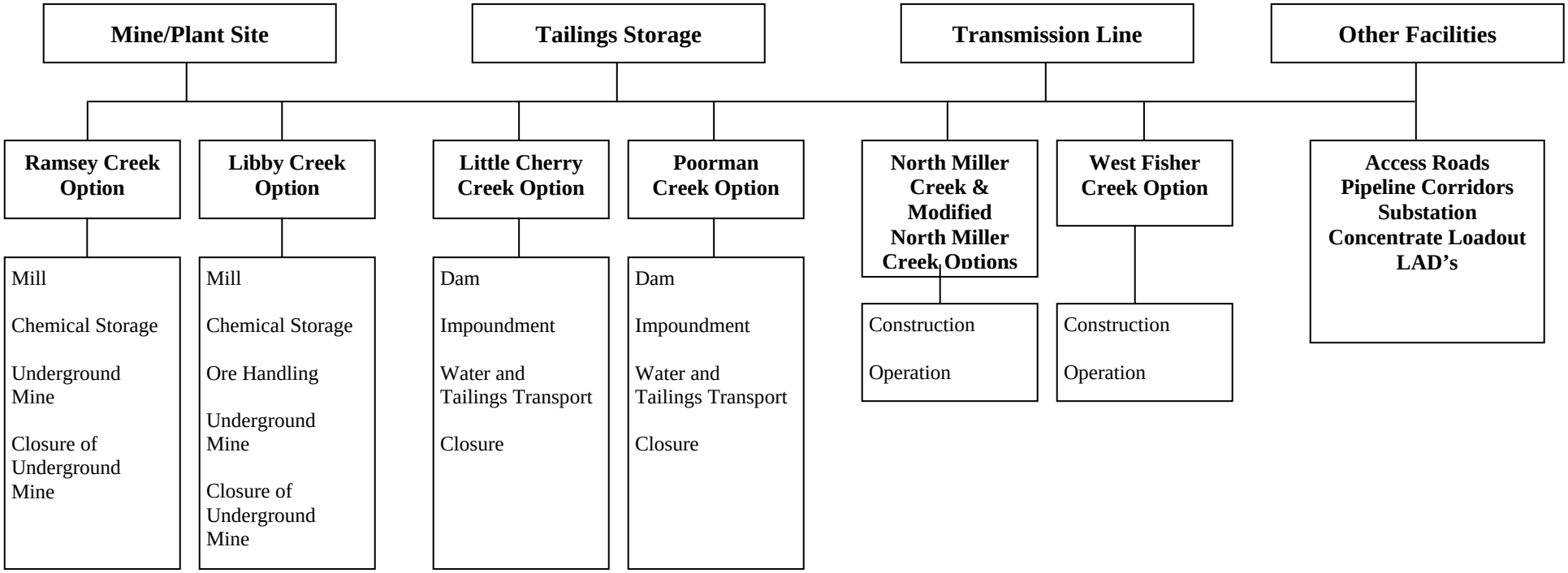


**Figure 3.2 FMEA Components and Sub-Components**

## 3.2 FMEA Workshop

The basic structure of the FMEA combines failure modes identified for each component with the defined likelihood, consequence and confidence categories. In addition, both current and future compensating factors are addressed. Current factors are those which in various ways have influenced the assigned likelihoods or consequences, while future factors are those which could also be considered to mitigate failure mode risks.

The FMEA reflects the judgments expressed by the technical representatives of the contributing Government Agencies and Consultants during the workshop held on March 6, 2008, and in the follow-up teleconference sessions. The contributing agencies and consultants include:

- US Forest Service;
- Montana Department of Environmental Quality;
- Wildlife and Fisheries from the Kootenai National Forest;
- ERO Resources Corp.- Consultant for preparation of the EIS;
- Klepfer Mining Services – Consultant for Mines Management Inc.; and
- Klohn Crippen Berger Ltd. – Consultant for tailings facility and risk assessment

During the workshop, all potential failure modes or potential problems were identified for the project components for the project phases of construction, operations and closure. An assessment of the likelihood of failure and the consequences of each failure mode were then quantified. The risk is the product of likelihood times consequence.

## 3.3 Likelihood of Event

The likelihood of event was quantified on a 5 level scale (A to E) based on the annual probability of failure and likelihood of occurrence. Table 3.1 summarizes the five levels and gives examples of typical events in each level. In some cases a failure event consists of not just a single occurrence, but a string of events in a failure sequence. In such cases, the likelihood refers to the combined likelihood of the event in the sequence.

**Table 3.1 Summary of Likelihood Criteria**

| LEVEL | ANNUAL PROBABILITY | LIKELIHOOD OF OCCURRENCE | RETURN PERIOD (YR) | TYPICAL EXAMPLES |
|---|---|---|---|---|
| E - NEGLIGIBLE | $<10^{-4}$ | <0.1% chance of occurrence | > 10,000 | Conceivable but improbable. |
| D – VERY LOW | $10^{-3}$ to $10^{-4}$ | 0.1%-1% chance of occurrence | 1,000 to 10,000 | Rare: probable maximum flood, maximum credible earthquake, lightning strike death. |
| C - LOW | $10^{-2}$ to $10^{-3}$ | 1%-10% chance of occurrence | 100 to 1,000 | Possible: intermediate earthquakes and floods, suicide. |
| B - MODERATE | $10^{-1}$ to $10^{-2}$ | 10%-50% chance of occurrence | 10 to 100 | Likely: open pit slope failures, concrete degradation, death in a motor vehicle accident, cancer. |
| A - HIGH | $> 10^{-1}$ | >50% chance of occurrence | < 10 | Certain: pump shutdown, pipeline breakage, motor vehicle accidents, QA/QC excursions. |

The likelihood levels defined are understood to be on an annual basis, and thus must be accumulated over the relevant exposure period. During the relatively short life of the project annual probabilities generally reflect what could happen; however, for post-mining land use, where the time period can be in the order of 1,000 years, even events with a low likelihood are expected to occur. The closure risk, therefore, of time dependent risks was factored into the binning process by scaling up to the next level of likelihood to reflect the longer exposure period.

Some risks are not cumulative with time and these include the potential for acid rock drainage/metal leaching and mining components in which the likelihood is based on the actual geology, hydrogeology and geochemistry. These risks do not increase with an increasing time exposure.

## 3.4 Consequence of Event

The second component of risk is consequence. Consequences of the events were ranked on a 5 level (1 to 5) level scale in four main categories:

- **Water Quality:** Includes potential effects on receiving surface water and groundwater quality in terms of water chemistry and water flow. The "water" consequence also considers the potential influence of the mine workings on the lake levels in the Cabinet Mountains Wilderness area;
- **Biophysical:** Includes area disturbance to stream, terrestrial and wetland habitat, and effects on aquatic populations and threatened and endangered (T & E) species;
- **Community/Social:** Includes economic costs of local or national communities, land use and relocation, archaeology and potential for loss of life and people affected; and
- **Cost:** Includes direct economic cost and remediation costs, and indirect public image and community relations costs.

Table 3.2 summarizes the consequence criteria that were used for this assessment.

## Table 3.2 Summary of Consequence Criteria

| CATEGORY | WATER QUALITY/QUANTITY | | BIOPHYSICAL | | COMMUNITY-SOCIAL | COST |
|---|---|---|---|---|---|---|
| | Surface Water | Groundwater | Stream Habitat/Aquatic Life | Terrestrial and Wetland Habitat | | |
| (1) INSIGNIFICANT | No detectable changes relative to "background" conditions. | No detectable changes relative to "background" conditions. | No measurable change from baseline conditions. | No measurable changes. <5 acres of wetlands affected. | No measurable changes. | < $1 million |
| (2) MINOR | Minor changes, occasional exceedance of chronic water quality standards. <10% change in base flow or lake levels. | Minor changes, occasional exceedance of groundwater quality standards. | Area of productive habitat effect is limited to < 5%. <15% annual reduction in aquatic populations. May affect T&E species but not likely to adversely affect. | <10 % of terrestrial habitat lost. May affect T&E species but not likely to adversely affect. Between 5 to 30 acres of wetland affected. | No negative effect in the socio-economics of local communities. Affects < 10 people and no loss of life. | $1 million to- $10 million |
| (3) MODERATE | Exceedance of chronic water quality standard within 25%, on a regular basis. Sediment load between twice and 5 times baseline. Base flow or lake level change of 10 to 20%. | Exceedance of groundwater quality standards on a regular basis. | Area of productive habitat effect is limited to 5% to 25%. 15% to 25% annual reduction in aquatic populations. For T&E species may affect and would likely adversely affect. | 10% to 30% of habitat loss. Less than 15% change in population of wildlife species. For T&E species would likely adversely affect. Between 30 acres to 50 acres of wetlands affected. | Reduction in the social and economic conditions of local communities. Affects 10 to 100 people. Potential for 1 life lost. | $10 to 100 million |
| (4) MAJOR | Up to 50 times chronic water quality standards (regularly exceeding acute standards). Sediment load between 5 and 100 times baseline. Base flow or lake level change > 20%. | Up to 50 times groundwater quality standards on a regular basis. | Area of productive habitat effect is limited to 25% to 50%. > 25 % annual reduction of aquatic populations. T&E species may affect and would likely adversely affect. | Between 30-50% of habitat lost. Local population viability threatened for wildlife species. Between 50 acres to 100 acres of wetlands affected. | Reduction in the social and economic conditions state wide. Affects 100 to 1,000 people. Potential for <10 lives lost. | $100 to 500 million |
| (5) CATASTROPHIC | Over 50 times chronic water quality standards (regularly exceeding 10 times acute standards). Sediment loads greater than 100 times baseline for more than a month. 100% of lake level or base flow change. | Over 50 times groundwater quality standards. | Area of productive habitat effect is > 50%. Large scale loss of aquatic population. | >50 % habitat lost. Large scale loss of wildlife populations. > 100 acres of wetlands affected. | Reduction in the social and economic conditions nation wide. Affects > 1,000 people. Potential for 10 or more lives lost. | >$500 million |

## 3.5 Confidence Level

Judgments on likelihood and consequences made by workshop participants may vary substantially in their associated degree of confidence depending, for example, on amount and consistency of available information for an informed opinion. The level of confidence in the likelihood of failure and/or the consequences is illustrated on a 3 level scale as follows:

- **Low (L):** Do not have confidence in the estimates, potential for high variability;
- **Moderate (M):** Have some confidence, and potential for moderate variability; and
- **High (H):** Have confidence, and potential for low variability.

Risk items with a Low Confidence Level were "binned" up to the next likelihood category to reflect the uncertainty.

## 3.6 Compensating Factors

For each failure mode and effect there may be compensating factors that could be introduced to reduce the risk. The compensating factors could include some of the following general components:

- Specific QA/QC programs to ensure compliance with design;
- Additional engineering and scientific studies;
- Habitat compensation and mitigation;
- Training and communication plans;
- Monitoring programs and response measures; and

- Civil works to increase factors of safety.

Where applicable, the compensating factors that become part of the risk management plan should be considered when quantifying the likelihood and/or consequence of the risk item.

## 3.7 Binning, Risk Charts and Risk Levels

A screening (binning) process was used to identify the main risk levels. The risk levels are shown schematically in the Risk Chart (see Figure 3.3) and the criteria for classifying risk levels, from high risks to low risks, are summarized as follows:

- Risk Level 5: (A-5), and are classified as "fatal flaws". Level 5 risks are unacceptable and are classified as “fatal flaws”, which means that a new design is needed or the project should not go ahead;
- Risk Level 4: (B-5); (A-4). Level 4 risks are of concern to senior management, shareholders, and the potentially affected public. They require a high level of scrutiny and detailed risk management and contingency plans;
- Risk Level 3: (C-5); (B-4); and (A-3). Level 3 risks are of concern of senior management, engineering design and operating staff. They require a risk management plan and contingency plan;
- Risk Level 2: (D-5); (C-4); (B-3); and (A-2). Level 2 risks are of concern to the Engineering design and operations staff and require operating procedures and risk management plans to manage the risks;
- Risk Level 1: (E-5); (D-4); (C-3); (B-2); and (A-1). Level 1 risks are of concern to the engineering design and operations staff and require operating procedures and risk management plans to manage the risk; and
- Risk Level <1: (B-1, C-1, C-2, D-1, D-2, D-3, E-1, E-2, E-3, E-4) Risks less than Level 1 risk are considered to be inconsequential; however, they are presented in the risk tables for completeness.

## Binning Adjustments

There were two types of adjustments made during the binning process:

- Risks with a low level of confidence were "binned" out as equivalent to the next highest likelihood category; and
- The time frame for closure is in the order of 1,000 years and, therefore, the risk exposure is higher for items which could occur over the longer term. Accordingly, risk items that are "exposed" for the closure period were "binned" out as equivalent to the next highest likelihood category.

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 - CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| | | | 100.5 | | |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3 | RISK LEVEL 1 C, 3 | RISK LEVEL 2 B, 3 | RISK LEVEL 3 A, 3 |
| | | 100.1 | 100.6 | 100.2, 200.1 | |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2 | RISK LEVEL 1 B, 2 | RISK LEVEL 2 A, 2 |
| | | | | 100.4 | 100.8 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1 | RISK LEVEL <1 C, 1 | RISK LEVEL <1 B, 1 | RISK LEVEL 1 A, 1 |
| | | | | 100.7 | 100.3, 300.1 |

**Figure 3.3 Typical Risk Chart Showing Risk Levels**

# 4. RISK ASSESSMENTS FOR THE PLANT SITE AND UNDERGROUND MINE

## 4.1 General

The risk assessment was carried out the underground mine and for the two plant site alternatives, Libby Creek Plant Site and Ramsey Creek Plant Site. The risks for the two alternatives are very similar.

## 4.2 Libby Creek Plant Site and Underground

### 4.2.1 Risks Identified

Risk worksheets and risk charts for the Libby Plant Site are included in Appendix I as Table I-1.1 and Table I-1.2. Risk worksheets and risk charts for the underground mine are included in Appendix I and discussed in the following sections.

#### 4.2.1.1 Plant Site Risks

The processing plant facilities include: grinding circuit (ball and rod mills), coarse ore stockpile, flotation cells, thickeners, workshop/warehouse, offices, runoff sediment ponds and laydown areas. The facilities, for the most part, consist of non-hazardous industrial materials and the main risks are associated with damage to the plant and safety issues. The identified risks include the following:

- Item 100.1 – Avalanche, landslides, mass wasting, earthquake (RL < 1)

  The mine is located in a relatively stable geologic environment and natural geohazards have a low risk.

- Item 100.2 – Forest fire (RL = 2)

  The likelihood of a forest fire during the life of the mine is significant and there is a risk that it could “engulf” the plant site area and mine facilities. Normally, there would be sufficient notice to evacuate personnel and the main consequences will be property damage and potential release of

chemicals and burnt fuel during the fire. The mine would have an emergency response plan to address this risk.

- Item 100.3 – Loss of power (RL < 1)

  Loss of power, either due to damage of the transmission line or supply system would temporarily shut down the milling operations until it was repaired. Standby power would be available for emergency use and for underground ventilation.

- Item 100.4 – Extreme precipitation (rain on snow event) (RL = 1)

  An extreme precipitation event could overtop the sediment control pond and cause damage to the berms and ditches, which could result in a temporary release of sediment to the downstream receiving streams.

- Item 100.5 – Plant fire – wildfire (RL = 2)

  The risk addresses the potential for a fire in the plant to lead to a forest fire, which could then extend beyond the mine area. The plant site will have a fire control plan and will have facilities to expedite extinguishing a fire in the plant.

- Item 100.6 – Plant fire – internal (RL = 1)

  This risk addresses the internal damage caused by a fire in the plant, which is mainly related to the potential for a loss of life or the financial cost of repair.

- Item 100.7 – Vandalism (RL < 1)

  Vandalism would mainly lead to additional cost of repairs.

- Item 100.7 – Equipment failure (RL = 2)

  Equipment failure, or the failure of personnel to properly operate equipment, could lead to spills of reagents, or overtopping of the sediment control pond, or process tanks, which could have some impact on water quality and the biophysical environment. Management of these risks are addressed with internal Health, Safety and Environment procedures and Operation and Maintenance Manuals and Procedures for all main equipment and operations.

#### 4.2.1.2 Chemical Storage Facility and Ore Handling Risks

The plant site will have storage tanks for fuel and oil, which will be in conventional lined facilities. Mill reagents will be stored in tanks and consist of bio-degradeable xanthates and other reagents. Explosives will be stored in a separate area away from the industrial plant.

- Item 200.1 – Equipment and operator failure (RL = 2)

  The main risk associated with the facilities is due to equipment or operator error that could lead to a spill or accident.

- Item 200.2 – Fire, equipment failure of conveyor (RL < 1)

  The ore conveyor from the mine to the plant site crosses a creek and failure of the conveyor, either due to a fire or equipment failure, could lead to a localized spill of ore. This could be cleaned up will little impact.

#### 4.2.1.3 Underground Mine Risks During Operations

The underground workings will consist of two main access ramps leading to a "room and pillar" mining operation. The pillars are rock columns left in place to support the overall rock mass. Rock will be mined, loaded into trucks and taken to the plant site for processing. Some waste rock will be backfilled into some sections of the mine openings. Mine water will be collected and used in the milling process and/or discharged into the LAD areas. The main risks are summarized as follows:

- Item 300.1 – Unpredicted ARD: (RL <1)

  The mine rock contains very low concentrations of sulphides and the probability of acid rock drainage occurring during operations is very unlikely because the very long "lag" time that could be required even if ARD were to be possible.

- Item 300.2 – Near neutral pH – metal leaching – metal concentrations an Order of Magnitude Larger (RL = 1)

  The mine rock has very low concentrations of metals associated with near neutral pH leaching of the rock and the likelihood of increased concentrations is low.

- Item 300.3 – Major ground failure in mine leading to wilderness impacts (RL <1)

  A major ground failure, leading to subsidence on the surface, would require collapse of many of the supporting pillars, and even then, is seen as unlikely due to the thickness of rock between the mine and the surface and the expected "bridging" that would occur. The main concern with this risk is the potential for any disturbance to the wilderness area, which could theoretically be manifested with settlement near the wilderness lake and changes to the water levels in the lake. This potential consequence is anticipated to also be mitigated with lakebed sediments, which could accommodate some settlement before being disrupted enough to modify lake levels.

- Item 300.4 – Mine fires/explosion (RL = 1)

  Mine fire and accidents with explosives are considered to be low likelihood with modern equipment and safety programs.

- Item 300.5 – Ground control – internal (RL = 3)

  There is always some risk associated with ground control due to the potential variability of the actual geology and rock conditions underground. The main risk is the potential for loss of life due to a rock fall. This risk will require a good health and safety and monitoring plan to ensure safe working conditions at all times, as well as good geotechnical engineering of the mine openings during all stages of mine development.

- Item 300.6 – Equipment failure/accident (RL = 3)

  Accidents associated with either equipment failure or worker error could lead to a loss of life.

- Item 300.7 – Mine inflow (RL <1)

  Unexpected geologic conditions and high groundwater inflows could occur if a large fault zone were to be encountered that was acting as an aquifer and could supply water to the mine opening. This is considered to be a low risk because of the experience gained from the existing Libby decline, which has not indicated any unusual mine water conditions.

- Item 300.8 – Unpredicted wilderness groundwater impacts (order of magnitude greater than predicted) (RL = 2)

  This risk items considers that a large groundwater inflow could lead to lowering of the lake levels in a wilderness area lake or reduce groundwater discharge to springs, wetlands and streams.

- Item 300.9 - Major ground failure in mine leading to mining shutdown (RL = 2)

  The risk involves a major ground failure leading to collapse of a significant portion of the mine and loss of life, and temporary or permanent closure of the mine. While the likelihood of such an event is low, the high consequence requires that good geotechnical design and ground control will be required to reduce this risk.

#### 4.2.1.4 Risks from Underground Mine during Post-Closure

- Item 400.1 – Unpredicted ARD post bond release. (RL <1)

  The risk of long term unpredicted ARD is expected to be low as the mine working will be flooded on closure and the regional groundwater levels would be re-established, although there would be some modifications.

- Item 400.2 – Portal plug failure (RL <1)

  The portal plug, over a period of time, will cause the natural groundwater levels in the hillside to become re-established. Failure of the plug would release some water that is stored in the decline and modify the groundwater levels in the hillside. The portal plug, however, can be designed and built to ensure long term performance.

- Item 400.3 – Post Bond Release – Near neutral pH metal leaching (RL <1)

  Could lead to exceedence of water quality standards in springs/seeps.

- Item 400.4 – Major Ground Failure (RL <1)

  The risk of major ground failure post-closure, leading to surface subsidence, will be similar to the risk during operations and is low.

- Item 400.5 – Unpredicted Wilderness Groundwater Impacts (Order of Magnitude or Greater) (RL <1)

  The likelihood of the groundwater regime changing enough to result in an order of magnitude change in either wilderness lake levels or groundwater springs and flows in the region, due to the mine on closure is very low because the portal plug and infilling of the mine will lead to "near" re-establishment of the pre-mining groundwater regime.

### 4.2.2 Risk Management Plans

The Level 3 Risks and Level 2 Risk are summarized in Table 4.1 and Table 4.2, respectively, and discussed in the following sections. Level 1 Risks are summarized in Table 4.3.

**Level 3 Risks**

Items 300.5 and 300.6 are risks of accidents underground either due to rock control or equipment/operator error that could lead to loss of life. These risks will be managed with training and an environmental health and safety plan (EHSP).

**Table 4.1 Libby Plant Site and Underground - Risk Management Plans - Level 3 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 300.5 | Ground failure leading to loss of life. | Mine safety is extremely critical and a comprehensive Environmental Health and Safety Plan (EHSP) will be implemented. The mine workings will be regularly assessed by a professional engineer to assure safe working conditions. |
| 300.6 | Equipment failure/accident leading to loss of life. | Mine safety is extremely critical and a comprehensive Environmental Health and Safety Plan (EHSP) will be implemented. |

**Level 2 Risks**

Items 100.2 and 100.5 are either due to forest fires engulfing the plant site or some event at the plant site triggering a local wildfire. Fire awareness and fire prevention training will be an integral part of the EHS program. Item 100.8 is a spill due to equipment failure and this risk will be addressed in the spill management and spill response plans.

Item 300.8, the potential for the mine operations to influence the wilderness groundwater levels (by an order of magnitude or greater), while not expected to be able to create a measureable change in water levels, is a risk because of the criterion of leaving the wilderness areas unchanged.

**Table 4.2 Libby Plant Site and Underground - Risk Management Plans - Level 2 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.2 | Forest wildfire leading to damage to plant site. | A forest fire awareness and response plan will be implemented as part of the EHSP. |
| 100.5 | Fire from plant site leading to a forest wildfire. | A fire awareness program and internal fire response plan will be implemented as part of the EHSP. |
| 100.8 | Equipment failure leading to spill from plant site. | This will be addressed as part of the EHSP and spill response plans will be implemented. |
| 200.1 | Chemical/fuel spill due to operator error and release of 10,000 gallons of "product". | This will be addressed as part of the EHSP and a spill response plan will be implemented. |
| 300.8 | Unpredicted wilderness groundwater impacts decreases groundwater discharge to wetlands. | Lake levels in the wilderness area will be monitored, along with the climatic conditions to assess and monitor any potential effects. |
| 300.9 | Major ground failure leading to loss of life and temporary or permanent mine closure. | Good geotechnical design and monitoring of geotechnical stability. |

## Level 1 Risks

Level 1 Risks are summarized in Table 3.1.

**Table 4.3 Libby Plant and Underground - Risk Management Plans - Level 1 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.4 | Flood leading to pond overflow and property damage. | The facilities will be designed to accommodate a 1:100 year flood event. An emergency response plan will be incorporated into the Operations, Maintenance and Surveillance Manual for the facility. |
| 100.6 | Internal plant fire that leads to plant shutdown, potential loss of life. | An internal fire response plan will be implemented as part of the EHSP. |
| 300.2 | Near neutral metal leaching higher than predicted. | Groundwater will be monitored and if metal leaching levels are high water treatment will be carried out. |
| 300.4 | Mine fire/explosion leading to property damage, potential loss of life. | Mine safety is extremely critical and a comprehensive Environmental Health and Safety Plan (EHSP) will be implemented. |
| 400.1 | Post bond release - unpredicted ARD. | Testing and monitoring during operations and post closure to improve predictive models. |
| 400.2 | Portal plug failure. | "Robust" plug design. |

The main potential closure risks are related to potential changes in water quality and failure of the portal plug.

## 4.3 Ramsey Creek Plant Site and Underground

The risk assessment for the Ramsey Creek Plant Site and underground is essentially the same as for the Libby Creek Plant Site, except that ore conveyor would not cross a creek. Nonetheless the risk level for ore conveyors is RL < 1, which is not significant. The risk worksheet and risk chart for the Ramsey Creek Plant Site alternative are included as Table I-2.1 and Table I-2.2 in Appendix I.

# 5. RISK ASSESSMENTS FOR THE TAILINGS IMPOUNDMENT

## 5.1 General

The risk assessment was carried out for both Little Cherry Creek and the Poorman Creek alternatives. In general, the risks for Poorman are similar to Little Cherry Creek and any differences in risk or risk management are presented in the section on Poorman Creek.

## 5.2 Little Cherry Creek Tailings Impoundment

### 5.2.1 Risks Identified

A risk assessment was carried out both with the Risk Workshop participants and internally with specialists from KCBL, based on the designs presented in the tailings design report. Risks were categorized as dam safety risks, tailings impoundment risks, tailings-associated facilities risks, and closure risks. The risk worksheet and risk chart for the Little Cherry Creek Tailings Impoundment alternative are included as Table I-3.1 and Table I-3.2 in Appendix I.

#### 5.2.1.1 Dam Safety Risks

In general, the tailings dam stability is controlled by consideration of the pore pressures in the foundation glaciolacustrine clay during operations and by the desire to have a flat slope (i.e. 4H:1V) that is amenable to closure reclamation. The factors of safety continue to increase, after closure, as the pore pressures in the clay continue to dissipate, resulting in a conservative final factor of safety for closure. The following risks have been identified, and although considered to be low risks, they will continue to require careful design, construction and monitoring, to confirm the design parameters.

- Item 100.1 – Pore pressures in glaciolacustrine clay are higher than predicted (RL = 1)

  Glaciolacustrine clay has been identified in the foundation of the Main Dam in the vicinity of the buried channel. The clay thickness varies from a few feet up to 25 ft, although the gradation (contains zones of outwash sand/gravel) and the spatial extent is variable because of the intermittent deposition history. Shear keys will be excavated in the clay and backfilled with compacted till, as required to meet the design factors of safety. The spatial extent of the clay will be further defined during the detailed design, construction and ongoing operational stages. Piezometers will be installed in the clay to measure and monitor the actual pore pressure response to verify the design. The dam slope may need to be flattened, or steepened, depending on the actual pore pressure response.

- Item 100.2 – Higher than predicted uplift pressures reduce dam stability (RL <1)

  Higher than predicted uplift pressures, due to regional groundwater gradients, may require installation of pressure dewatering wells. The risk is considered to be low because the dam stability is controlled by the foundation clays and consequently, the flat dam slopes could accommodate significant uplift pressures without being a stability concern. The pressures will be monitored during operations and depressurization wells would be installed, if required.

- Item 100.3 – Loose glacial outwash layer liquefies under seismic loading (RL = 2)

  Given the deposition history of the glacial outwash silty sands and gravels, there is a low likelihood that localized pockets of material could be loose and could liquefy under seismic loading. The potentially loose material would be expected to occur in the upper 20 ft to 40 ft of the foundation. Below this depth the soils comprise mainly of dense glacial tills, which have had considerable consolidation. Although loose materials have not been identified in the site investigation program, standard penetration tests in bouldery granular material are difficult to carry out and are limited to the specific borehole locations. Accordingly, a sensitivity study was carried out to assess what spatial extent/continuity of loose material would be required to reduce the factor of safety below the design criteria. The sensitivity study indicated that the liquefiable soils would need to occur

over 40% along the length of the failure surface, with a continuous width of about 300 ft, which is considered highly unlikely.

- Item 100.4 - Tailings dam underdrains plug causing higher than expected pore pressures in dam (RL <1)

  The underdrains may become plugged with cyclone sand if the underdrains were constructed with material outside of specifications or as a result of poor construction quality control, although this is considered to be unlikely if quality control and quality assurance measures are applied for construction.

- Item 100.5 – Tailing impoundment underdrains plug over time and increase uplift pressures in the dam and reduce stability (RL= 1)

  The risk is low because the dam is designed for potentially higher pressures and the expected low pressures will actually increase the stability over the design case.

- Item 100.6 – Decreased efficiency of the cyclone (RL <1)

  Due to variation in the tailings properties or mechanical problems, the cyclones may not produce enough cyclone sand for dam construction, or the underflow may contain too many fines. Insufficient cyclone sand may require borrow material. Increase in fines may require additional compaction effort for dam construction.

- Item 100.7 – Inadequate quantity of cyclone sand (RL <1)

  The likelihood is considered low due to comparison with similar projects and the relatively "good" quality of the tailings for cycloning. If necessary, borrow material could be used to augment the sand volumes.

#### 5.2.1.2 Tailings Impoundment Risks

The water quality risks are associated with the flux of process water that will be "squeezed" from the tailings as it consolidates, and with potential surface water infiltrating through the tailings and "flushing" out process water from the pore space of the tailings. The fate and transport of the process water flux is influenced by: 1) the

efficiency of the underdrain collection systems and the potential for flow to bypass these systems; 2) the attenuation/adsorption capacity of the soils; and 3) the mixing with receiving water. The seepage collection systems include the underdrain system and seepage collection pond, with groundwater monitoring and pump-back wells as a contingency. The main risks include the following:

- Item 200.1 – Underdrains plug during operations and/or closure (RL < 1)

  There is a low possibility that some of the underdrains could become plugged due to poor construction, or the presence of unexpected materials that lead to piping of soil or tailings into the drains. Possible increase in loading to the groundwater regime was estimated to be 50%. Seepage collection wells could be used to intercept the impacted groundwater.

- Item 200.2 – "Natural" groundwater spring(s) "feed" directly into the underdrain system (RL <1)

  The baseline groundwater model estimates that the total groundwater flux, from the entire groundwater catchment area, is in the order of 50 gpm to 200 gpm, with a "best estimate" of approximately 80 gpm. The seepage collection and water return system will have a design capacity of 2000 gpm, and the net average water deficit during operations varies from 400 gpm to 800 gpm. Therefore, the addition of localized springs into the underdrain system can be accommodated with the current design.

- Item 200.3 – Tailings permeability higher than design (RL = 1)

  A higher tailings permeability than used for design could potentially result in an estimated 30% increase in the infiltration of tailings water into the foundation. Seepage collection wells could be used to intercept impacted groundwater.

- Item 200.4 – Decant water pond "moves" over the pervious native material, or underdrains (RL = 1)

  This would only be a temporary scenario, if it were to occur, and tailings discharge would be modified to move the pond, or to cover the permeable area with tailings.

- Item 200.5 –"Loss" of water from underdrains into the foundation groundwater (RL = 1)

  The design of the underdrains includes a partial HDPE geomembrane lining of the base of the underdrain to reduce the risk of leakage to the foundation groundwater system. The lined portion of the underdrains will transport the design flow, which would only be exceeded either through a system upset, such as the decant water pond feeding into a drain, or an extreme flood event. Any system upset would be temporary and, in addition, the zone of leakage would need to be hydraulically connected to the bedrock aquifer, further reducing the risk.

- Item 200.6 - "Pervious" soil connection between the tailings and the bedrock aquifer increases contaminant loading to the aquifer (RL = 2)

  The foundation permeability could be higher than expected due to possible pervious soils along Libby Creek, Little Cherry Creek and old creek channels. These pervious soils may allow tailings water to pass underneath the seepage collection system via the overburden or the bedrock aquifer. The increase in infiltration loading was estimated to be 30%. An unknown pervious connection to the aquifer could influence water quality outside of the tailings area. Groundwater wells will be installed to monitor the water quality and interception wells would be installed if required. The risk level is mainly affected by the level of confidence in predicting such flow paths and the potential cost of interception wells.

- Item 200.7 – "Pervious" soil connection between main trunk drain and bedrock aquifer (RL = 1)

  This risk is similar to Item 200.6, although the level of confidence is higher because the drain is an engineered structure with QA/QC and the cost of remediation may be lower.

- Item 200.8 – "Unknown" aquifer connection through buried channel to Libby Creek (RL= 1)

  An unknown aquifer connection could potential transport seepage water into Libby Creek. Similar to Item 200.6, this potential risk will be monitored and interception wells installed if required.

- Item 200.9 – Inadequate freeboard (RL <1)

  This would result in an overtopping failure. However, the facility is designed to store the probable maximum flood, so this scenario is extremely unlikely.

- Item 200.10 – "Unknown" aquifer connection to Little Cherry Creek (RL = 2)

  This risk is similar to Item 200.8, however the consequence is considered to be higher due to the relatively lower flow in Little Cherry Creek.

#### 5.2.1.3 Risks from Tailings, Surface Water and Associated Facilities

The associated facilities have low risk levels that are mainly influenced by shutdown of equipment, and pipeline breaks. The following risks related to tailings associated facilities have been identified.

- Item 300.1 – Tailings and Water Reclaim Pipeline breaks (RL = 1)

  Pipelines will be placed in lined channels. A monitoring system and contingency plan are in place to handle pipeline break events. As a result, the risk of significant damage is unlikely.

- Item 300.2 – Pump barge breakdown for extended period (RL <1)

  Provide an extra storage volume for at least 1 week of operations, which will allow time to fix the pumps or get replacement pumps. In addition, the tailings underdrain system and seepage pumpback system is designed for the full capacity. All pump systems will have a backup pump system available.

- Item 300.3 – Shutdown of thickener for extended time (RL <1)

  This would increase the volume of tailings and water in the tailings impoundment. The dams may need to be raised higher to accommodate the higher volume of water.

- Item 300.4 – Seepage collection system breakdown for extended time (RL = 1)

  The seepage collection pond can store all water for 1 week, which will allow time to fix the pumps or get replacement pumps. All pump systems will have a backup pump system.

- Item 300.5 – Diversion channel blockage (RL < 1)

  Landslide into the diversion channel is a low risk that is mitigated by the large capacity of the channel. Plugging of the channel would need to be combined with an extreme event, which would lead to discharge of a large sediment load as the material is eroded. Plugging of the diversion channel would not affect the stability of the tailings dam.

- Item 300.6 – Diversion channel blockage (RL < 1)

  Plugging of the diversion channel outlet and water overtopping the diversion dam into the impoundment is a low risk that is mitigated by the large capacity of the channel.

#### 5.2.1.4 Closure Risks

The closure risks are mainly related to either the physical/biophysical components or to the long term water quality aspects. Long term dam stability risks decreases significantly due to drainage of the pile and dissipation of construction pore pressures. The time frame for closure is in the order of 1,000 years and, therefore, the risk exposure is higher for items which could occur over the longer term. Accordingly, the likelihood for risk items 400.3, 400.4, 400.5, 400.6 and 400.7 were binned up to a higher risk level. Risk items, which are not time dependent, such as Items 400.1, 400.2 and 400.8, were not binned up to a higher risk level.

- Item 400.1 – Tailings too soft to reclaim (RL = 1)

  Selective spigotting will be carried out near the end of mine life to develop a beach sloping towards the southwest. The water pond will be drained and the tailings would continue to consolidate. If necessary, contouring

and placement of topsoil could be carried out when the ground is frozen, or geogrids could be used to provide support. Consolidation modeling indicates that the final consolidated surface should still provide positive drainage towards the northwest.

- Item 400.2 – Unsuccessful revegetation (RL <1)

  Additional growth medium may need to be placed. Test plots will be carried out during operations.

- Item 400.3 – Erosion due to extreme precipitation (RL = 2)

  The design of the final closure topography will distribute flows across the site to minimize concentration of flows. Temporary storage areas for extreme flow will be considered. The consequences of the erosion are mainly related to release of sediment which given the extreme precipitation, the receiving waters would also be experiencing a stressed situation with higher flows and the contribution of the tailings area would only be a small percentage of that flow.

- Item 400.4 – Underdrainage and Surface Water contamination (RL = 1)

  There is a risk that seepage collected from the underdrainage system will require treatment for a longer period of time, until natural flushing of the tailings improves water quality. Longer term treatment may be integrated with irrigation of the reclaimed impoundment area.

- Item 400.5 – Groundwater contamination (RL <1)

  There is a risk that groundwater flow paths could exist, that are able to transmit seepage water into the groundwater system and potentially, ultimately, into Libby Creek. The likelihood is mitigated by the complex flow paths and the upward gradients. Seepage collection wells may be required to intercept the contaminated groundwater. Groundwater will be monitored and interceptor wells installed, if required.

- Item 400.6 – ARD from tailings (RL <1)

  The geochemical characterization of the ore indicates low sulfur content and a low potential for acid generation. In addition, the milling process is expected to remove most of the sulfides from the tailings. The risk that after a period of several hundred years the neutralizing potential is consumed and low level acid generation and metal release occurs, is

considered to be very low. The consequences could result in degraded water quality in the seepage and underdrain collection, which could, in the worst case, require long term treatment.

- Item 400.7 – Diversion failure (RL <1)

  Landslide into the diversion channel is a low risk that is mitigated by the large capacity of the channel. Plugging of the channel would need to be combined with an extreme event, which would lead to discharge of a large sediment load as the material is eroded. Plugging of the diversion channel would not affect the stability of the tailings dam.

- Item 400.8 – ARD from waste rock used for construction (RL <1)

  The waste rock is tested for ARD potential throughout operations, so the possibility of acid generation from waste rock within the dam fill is very low. The consequences of acid generating waste rock could be water degradation and possibly requiring long term water treatment.

### 5.2.2 Risk Management Plans

Described in this section are the risk management plans recommended for the Little Cherry Creek Tailings Impoundment Facility, which are summarized in Table 5.1 and Table 5.2. The risks for the tailings facility were mainly associated with the strength and permeability of the dam and impoundment foundations. In addition, the long term closure risk is mainly associated with erosion.

**Level 2 Risks**

Risk Item 100.3 is related to the potential for loose liquefiable soils in the foundation. To date, drilling indicates that the potential layers are not extensive and would not control the stability of the dam. Additional studies and site investigations will be carried out both during detail design, construction, and operations and the dam slopes can be adjusted as required to ensure stability.

Risk Items 200.6 and 200.10 relate to the potential for "pervious" soil connections or "unknown" seepage paths that could transmit tailings seepage water into either the receiving bedrock aquifer or into Little Cherry Creek.

**Table 5.1 Little Cherry Creek Tailings - Risk Management Plans - Level 2 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.3 | Loose glacial outwash layer liquefies under seismic loading, leading to dam failure. | Dam design to assume that some material could liquefy. Additional site investigations will continue to better define the spatial extent of any loose layers. |
| 200.6<br><br>200.10 | "Pervious" soil connection between tailings and bedrock aquifer.<br><br>"Unknown" aquifer connection to former little cherry creek. | Install wells downstream of tailings facility for monitoring groundwater quality. Install pumping wells to intercept seepage if poor groundwater quality detected. Also, annually analyze tailings water balance and track seepage return flow to estimate seepage discharging into groundwater. |
| 400.3 | Erosion due to extreme precipitation on closure. | Closure design to reduce risk of erosion with riprap in potential high flow areas. Long term care and maintenance should provide for potential repairs after extreme events. |

**Level 1 Risks**

The main Level 1 Dam Safety risks include Item 100.1 which is the potential for higher than predicted pore pressures in the dam foundation and Item 100.5, which are increased phreatic levels due to plugging of the underdrains. Both risks can be managed with a monitoring program and, if required, localized flattening of the dam slope.

The main risks for the tailings impoundment area are associated with the potential for tailings water to enter the groundwater system, leading to potential contamination of groundwater downstream of the impoundment. Risk Level 1 items include Items: 200.3, 200.4, 200.5, 200.7 and 200.8. The risks will be managed with a comprehensive monitoring program and, if required, seepage collection pumpback wells.

## Table 5.2 Little Cherry Creek Tailings - Risk Management Plans - Level 1 Risks

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.1 | Pore pressures in glaciolacustrine clay are higher than predicted requiring flatter dam slopes. | Piezometers will be installed to monitor pore pressure response. Guidelines for "allowable" response and trigger levels will be developed. Dam slopes will be flattened if high pressures are measured. Additional site investigations will further define the spatial extent of the clay. |
| 100.5 | Tailings impoundment underdrains plug, with time, reducing dam stability. | Piezometers will be installed to monitor pore pressures. Dam design conservatively assumes high phreatic levels so that the impact on the dam slopes should be low. |
| 200.3 | Tailings permeability is higher than design leading to higher seepage losses. | Potential increase is within the range of accuracy of seepage estimates. Monitoring wells will be installed and interception wells will be installed if required. |
| 200.4 | Decant water pond "moves" over pervious native material leading to high seepage losses. | Monitor flow from underdrains. Adjust tailings discharge point to move pond away from pervious material, if underdrains flows rise unexpectedly. |
| 200.5<br><br>200.7<br><br>200.8 | "Loss" of water from underdrains into the foundation groundwater system.<br><br>"Pervious" soil connection between tailings and bedrock aquifer.<br><br>"Unknown" aquifer connection through buried channel to Libby Creek. | Monitoring wells will be installed downstream of tailings facility for monitoring groundwater quality. Install pumping wells to intercept seepage if poor groundwater quality detected. Also, annually analyze tailings water balance and track seepage return flow to estimate seepage discharging into groundwater. Revise underdrain design for future dam raises, as required. |
| 300.1 | Tailings or water reclaim lines from the mill site break and release tailings or process water. | Emergency procedures will be developed and included in the Tailings Facility Operation, Maintenance, and Surveillance Manual. The procedures will include a leak detection system, instructions for minor spills and requirements for full shutdown. Also, a spill response procedure will be required. |
| 300.4 | Seepage collection system breakdown for extended time leads to release of process water to little cherry creek. | A monitoring system will be in place and backup pumps will always be available. |
| 400.1 | Tailings too soft to reclaim – closure. | Schedule construction in winter with frozen soils. Use geogrids or other systems to allow trafficability. Use wetlands plants for reclamation. |
| 400.4 | Contaminated underdrainage and surface water leaves site – closure. | Continue monitoring water quality of flow from underdrainage and spillway during closure until metal concentrations have stabilized and are below criteria. Water treatment may be necessary if the water quality exceeds the criteria. |

## 5.3 Poorman Creek Tailings Impoundment

### 5.3.1 Additional Risk Items

The Poorman Creek Tailings Impoundment Alternative has a very similar risk profile as Little Cherry Creek, however, the following additional risk items arise due to the site location and the use of more complex technology. The risk worksheet and risk chart for the Poorman Creek Tailings Impoundment alternative are included as Table I-4.1 and Table I-4.2 in Appendix I.

#### 5.3.1.1 Dam Safety Risks

In general, the tailings dam stability is controlled by uncertainty in the foundations conditions. A dam slope of 2.5H:1V was selected for the Main Dam, but may be too steep if potential weak materials are encountered at the dam foundation. The following risk differences, from Little Cherry Creek, have been identified, and although considered to be low risks, they will continue to require careful design, construction and monitoring, to confirm the design parameters.

- Item 100.1 – Unexpected weak materials encountered at tailings dam foundation (RL = 2, versus RL = 1 for Little Cherry Creek)

  Limited field data was available to assess geotechnical conditions regarding strength pore pressure and permeability. Further geotechnical field investigation will need to be carried out prior to construction, and the dam design may need to be revised based on the findings. Piezometers will be installed in the foundation and dam to monitor pore pressures. The dam slope may need to be flattened if pore pressures are higher than predicted. The dam toe cannot extend beyond current limits because of the private property located 250 ft away, and Libby Creek located only 200 ft from the Seepage Recovery Dam. Significant re-design of the facility may be required to meet storage requirements, and it is possible that an alternate facility would be required.

#### 5.3.1.2 Tailings Impoundment Risks

The following additional risks are associated with the Poorman Creek Alternative and mainly relate to the proximity to private land.

- Item 200.11 - Foundation more permeable than predicted (RL = 2)

  Limited field data was available to assess the permeability of the foundation. Seepage collection wells could be installed to intercept the impacted seepage. However, full capture may be difficult because of the close proximity of Libby Creek and the private land.

- Item 200.12 – Deposited tailings density less than predicted (RL = 2)

  Selected tailings properties for design were estimated based on a very limited number of samples. The dam slope may need to be flattened if the deposited tailings density was less than predicted. The dam toe cannot extend beyond current limits because of the private property located 250 ft away, and Libby Creek located only 200 ft from the Seepage Recovery Dam. Significant re-design of the facility may be required to meet storage requirements. The tailings dam may need to be raised higher than expected to store the increased volume of tailings, or an alternate facility may be required.

- Item 200.13 – Mechanical breakdown of dewatering equipment and system upsets (RL = 1)

  The Poorman Alternative uses a more complex system of thickening and pumping, which could be more prone to operator error and system upsets.

#### 5.3.1.3 Risks from Tailings, Surface Water and Associated Facilities

The following risks difference related to tailings associated facilities have been identified.

- Item 300.7 – Dust emissions from dry tailings (RL < 1)

  Dusting may become a problem during the dry times of the year. The blown dust may impact the air quality of the private land. Dusting may be controlled by maintaining a wetted tailings beach surface by controlling

the discharge location of tailings. Water sprinklers and chemical surfactants could also be used to control testing.

- Item 300.8 – Noise pollution from mechanical equipment (RL < 1)

  Noise will be generated by heavy machinery when cycloning is in operations. This noise may lead to complaints from local landowners.

- Risk Items 300.5 and 300.6 (RL = 2)

  These risk items are similar to Items 300.7 and 300.8, except that the consequences lead to closure of the mine and/or a protracted legal dispute with the landowner.

#### 5.3.1.4 Closure Risks

The closure risks for the two facilities are similar, except for *Risk Item 400.5 (RL = 2)*, where the consequence of a groundwater risk leads to a protracted legal dispute with the landowner.

### 5.3.2 Risk Management Plans

Described in this section are the additional risk management plans recommended for the Poorman Creek Alternative, which are summarized in Table 5.3 and Table 5.4. The risk assessment is similar to Little Cherry Creek, however additional risks are added due to the very limited property constraints with a private land owner located at the toe of the dam. If changes are required to the dam layout, they will be constrained by the landowner and, in the worst case, an alternate new facility would be required. The close proximity of the landowner also adds additional risks associated with noise, dust and groundwater influences, which could, in the worst case, delay construction, halt operations, or require an alternate new site.

**Table 5.3 Poorman Tailings Facility - Additional Level 2 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.1 | Pore pressure in clay requires flatter slopes and less storage capacity. | Site investigation would be carried out. |
| 200.11 | Foundation more permeable than predicted affects local landowner and require more seepage control. | Site investigations would be carried out and the design modified to reduce seepage. Groundwater monitoring wells and interception wells would be installed. |
| 200.12 | Deposited densities less than predicted requiring more storage capacity. | Plant operations may require additional backup systems. Alternative storage areas would be considered. |
| 300.5 | Dust affecting local landowner leading to mine shutdown or delay. | Compensation agreement with local landowner. |
| 300.6 | Noise affecting local landowner leading to mine shutdown or delay. | Compensation agreement with local landowner. |
| 400.5 | Groundwater contamination leading to legal claims from local landowner. | Compensation agreement with local landowner. |

Note: These risks are in addition to those presented for Little Cherry Creek in Table 5.1.

**Table 5.4 Poorman Tailings Facility - Additional Level 1 and < 1 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 200.13 | Mechanical breakdown of thickeners/pumping. | The Operations, Maintenance and Surveillance Manual would identify maintenance requirements and operation guidelines to reduce risks of system upsets. |
| 300.7 | Dust affecting local landowner (RL < 1). | Sprinkling system |
| 300.8 | Noise affecting local landowner (RL < 1). | Soundproofing of plant building. Operation of heavy equipment only on dayshift. |

Note: These risks are in addition to those presented for Little Cherry Creek in Table 5.2.

## 5.4 Summary

The Poorman Creek Tailings facility has a higher number of Level 2 risks than the Little Cherry Creek Tailings facility. This reflects the limitations of the Poorman design because of its proximity to the private land and to Libby Creek. The facility does not have any room to expand, so a slight deviation in design assumptions, such as solids content and tailings density, may result in major design challenges. Also, dust emissions,

noise, and groundwater contamination could have a large economic impact if they result in complaints from the private land owner and lead to temporary or permanent shutdown or protracted legal issues.

The Poorman facility is also more at risk in terms of complexity of operations. The Poorman facility has both paste and cyclone operations. In comparison to the Little Cherry Creek facility, Poorman has more pumps, mechanical equipment and pipelines running to and from the dam crest. The higher amount of infrastructure would likely lead to a higher frequency of mechanical breakdowns and operator errors.

# 6. RISK ASSESSMENT FOR INFRASTRUCTURE

## 6.1 Mine Access Corridor

### 6.1.1 Access Road Risks

The main mine access road will run from the plant site to existing public roads as shown in Figure 2.7. In addition, local access roads will be required for the transmission line as shown in Figure 2.8. The mine access road will be used for transport of workers and supplies to the mine and for haulage of ore concentrate to the Concentrate Loadout facility in Libby. The risk worksheet and risk chart for the Roads, Pipelines, Loadout and LAD's are included as Table I-5.1 and Table I-5.2 in Appendix I.

- Item 100.1 – Accident/Equipment failure leading to a spill (RL <1)

  An accident or equipment failure, such as with a vehicle carrying mill reagents, explosives, fuel, etc. could cause localized effects in the area of the accident.

- Item 100.2 – Accident/equipment failure leading to a spill in a Riparian Habitat Conservation Area (RHCA) (RL = 1)

  This risk is similar to Item 100.1 except the accident would be within a RHCA and although the likelihood of failure is lower there is a higher consequence of failure.

- Item 100.3 – Accident leading to wildlife mortality (RL <1)

  There is a high likelihood that, during the life of the mine, that there will be a wildlife mortality due to an accident on the road.

- Item 100.4 – Accident leading to wildlife mortality of a threatened or endangered (T & E) species (RL = 2)

  This risk is similar to Item 100.3 except the accident would lead to wildlife mortality for a T&E species, which, although the likelihood is lower, the consequence is higher.

- Item 100.5 – Natural avalanche or landslide along the road leading to sediment loading (RL <1)

The main consequence of a landslide could be localized temporary sediment loads if it occurs near a water stream.

### 6.1.2 Pipeline Risks

- Item 200.1 – Pipeline failure or accident causing a spill (RL <1)

  A pipeline break would release a fixed volume of tailings and process water. A spill response plan would be in place to limit the effect and cleanup the spill. Pipelines will be designed with emergency "dump" ponds and monitoring devices to shut down the pipeline in the event of a failure.

- Item 200.2 – Pipeline failure or accident leading to a spill in a RHCA (RL <1)

  This risk is similar to Item 200.1 except the likelihood is reduced and the consequence is slightly higher.

- Item 200.3 Avalanche or landslide leading to break in the pipeline and a spill in a RHCA (RL <1)

  This risk is similar to Item 200.1 except the likelihood is reduced and the consequence is slightly higher.

### 6.1.3 Haulage and Transport Risks

- Item 300.1 – Spill of concentrate leading to local soil contamination (RL <1)

  An accident with the haulage of concentrate could lead to a localized spill, which would require cleanup. In general the spill would typically be of limited extent and could be cleaned up with only residual potential effects.

## 6.2 Land Application Disposal Risks

- Item 400.1 – Blocked ditches could lead to sediment loading or nitrate loadings to the environment (RL = 1)

  A monitoring and maintenance program will be implemented to maintain ditches.

- Item 400.2 – Equipment failure/operator error or preferential flow paths could lead to increased metal/nutrient levels in the surface/groundwater or sediment loads (RL = 2)

  A monitoring program will help to identify preferential flow paths.

- Item 400.3 – Exceedence of application rate increases loads to groundwater/surface water (RL = 1)

  A monitoring program will detect changes to the water quality and an alternate LAD would be developed, if required.

## 6.3 Risk Management Plans

Risk management plans for the Level 2 and Level 1 risks are summarized in Table 6.1 and Table 6.2 respectively.

**Table 6.1 Pipelines, Roads, Loadout, LAD's - Risk Management Plans - Level 2 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.4 | Road accident killing T&E wildlife. | Road safety would be part of the EHSP and speed limits would be enforced on all mine roads. |
| 400.2 | Equipment or human failure or preferred channels in LAD facilities. | Performance of LAD will be monitored to ensure timely response to system upsets. The OMS manual would define maintenance and operating criteria. |

**Table 6.2 Pipelines, Roads, Loadout, LAD's - Risk Management Plans - Level 1 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.2 | Road accident or spill in RHCA zones. | Road safety would be part of the EHSP and speed limits would be enforced on all mine roads. A spill response plan would be implemented. |
| 400.1 | Blocked ditches in LAS facility. | Performance of LAD will be monitored to ensure timely response to system upsets. The OMS manual would define maintenance and operating criteria. |
| 400.3 | Overloading of LAD facility. | Performance of LAD will be monitored to ensure timely response to system upsets. The OMS manual would define maintenance and operating criteria. |

# 7. RISK ASSESSMENTS FOR THE TRANSMISSION LINE

## 7.1 Transmission Line Alternatives

The risk assessment was carried out for three transmission line alternatives: 1) North Millar Creek Route; 2) Modified North Millar Creek Route; and West Fisher Creek Route. The conclusion of the risk assessment was that the risks for the three alternatives were similar and the results are presented in the following sections. The risk worksheets and risk charts for the three transmission line alternatives are included as Table I-6.1, Table I-6.2, Table I-7.1, Table I-7.2, Table I-8.1 and Table I-8.2 in Appendix I.

## 7.2 Transmission Line Construction Risks

- Item 100.1 – Equipment: vandalism, weather, wildland fires, landslide/avalanches or culvert collapse which lead to wildlife mortalities or displacement and sediment loading or power loss (RL =1).
- Item 100.2 – Accident with mobile construction equipment leading to a wildfire with loss of timber and sediment loadings to the environment (RL = 1).
- Item 100.3 – Equipment accident that leads to wildlife mortalities or displacement and increased disturbance (RL < 1).
- Item 100.4 – Poles and power lines: vandalism, weather, wildland fires, landslide/avalanches or culvert collapse which lead to wildlife mortalities or displacement and sediment loading or power loss (RL =1).
- Item 100.5 – Construction technique failures leading to wildlife mortalities or displacement and increased disturbance (RL < 1).

## 7.3 Transmission Line Operations Risks

- Item 200.1 – Inspection/repair: Vandalism, weather, wildland fires, landslides/avalanches or culvert failure leading to wildlife mortalities and displacement and increased disturbance (RL = 1).

- Item 200.2 – Inspection/repair: Crash (helicopter), lightening strike to poles leading to wildfire and timber loss (RL = 1).
- Item 200.3 –Inspection/repair: Accident leading to wildlife mortalities and displacement and increased disturbance (RL<1).
- Item 200.4 – Roads, structures, poles and communication facilities: Vandalism, weather, wildland fires, landslides/avalanches or culvert failure leading to wildlife mortalities and displacement and increased disturbance (RL = 1).
- Item 200.5 – Roads, structures, poles and communication facilities: Damage to facilities (loss of pole or power) from wildlife (RL <1).

## 7.4 Sedlak Park Electrical Substation Risks

- Item 300.5 – Sedlak Park Substation: Vandalism or earthquake leading to temporary loss of power (RL <1).

### 7.4.1 Risk Management Plans

Only Level 1 risks were identified and the risk management plan is presented in Table 7.1.

**Table 7.1 Transmission Line – Proposed North Miller Route - Level 1 Risks**

| ITEM | RISK | RISK MANAGEMENT PLAN |
|---|---|---|
| 100.1<br>100.2<br>100.4 | Construction: equipment failures (vandalism, wildfire, landslide, avalanche affect wildlife and sediment loads). | Design of the transmission line route will assess landslide/avalanche potential. An Environmental Health and Safety Plan (EHSP) would be implemented for construction safety and wildfire response. |
| 200.1 | Operations: vandalism, fires, landslides, avalanche – affects wildlife and sediment loads, power loss. | |
| 200.2 | Helicopter crash or lightening strike – wildfire and timber loss. | |
| 200.4 | Loss of poles or structures due to vandalism, wildfire, landslide, avalanche. | |

# 8. SUMMARY

The risk assessment identifies the main areas of risk associated with development and closure of the mine and assists the preparation of the Environmental Impact Statement. The risk assessment should also be used to guide the future development of the environmental health and safety plans (EHSP), the operations, maintenance and surveillance procedures (OMS) and the emergency preparedness and response plans (EPRP) for operation of the facility. The risk assessment should be updated throughout operations to reflect ongoing changes and optimization of risk management plans. A Risk Register of all Level 1, 2 & 3 risks should be prepared that identifies the person responsible for management of that risk item, along with an appropriately developed risk management plan, monitoring and annual reporting of the risks.

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Yours truly,

**KLOHN CRIPPEN BERGER LTD.**

Harvey McLeod, P.Eng.(BC), P.Geo.(BC)
Project Manager

Bob Chambers, P.Eng. (BC)
Project Reviewer

# APPENDIX I

# Risk Assessment Worksheets and Risk Charts

## Table I-1.1 Libby Plant Site

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Libby Plant Site | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| Mill Facilities | Grinding circuit, coarse ore stockpile, mill/shop facilities, offices, storage areas, pond, pad/foundation. | 100.1 | Avalanches, landslides, mass wasting, earthquake | Property damage, release of process water, mill chemicals, 1000 tons of tailings, potential loss of life. | O | D | 2 | 2 | 2 | 3 | H | D | **D, 3** | Avalanche Management Plan, Environmental Health and Safety Plan | | **<1** |
| | | 100.2 | Forest Fire | Property damage, access restriction, pipeline failure, plant shutdown, loss of life, chemical/process/tails release. | O | B | 2 | 2 | 3 | 3 | M | B | **B, 3** | Fire Control Plan | | **2** |
| | | 100.3 | Loss of Power | Temporary shutdown | O | A | 1 | 1 | 1 | 1 | H | A | **A, 1** | | | **<1** |
| | | 100.4 | Flood (Rain on Snow Event) | Pond overflow, property damage, erosion. | O | B | 2 | 2 | 1 | 1 | H | B | **B, 2** | Environmental Health and Safety Plan | | **1** |
| | | 100.5 | Plant Fire - Wildfire | Habitat loss (Wldfire), loss of life, loss of timber value, shutdown the operations, erosion. | C/O | C | 3 | 4 | 4 | 3 | M | C | **C, 4** | Fire Control Plan | | **2** |
| | | 100.6 | Plant Fire- Internal | Property damage, loss of life, temporary shutdown. | C/O | C | 1 | 1 | 3 | 1 | M | C | **C, 3** | Fire Control Plan | | **1** |
| | | 100.7 | Vandalism | Property damage | C/O | B | 1 | 1 | 1 | 1 | M | B | **B, 1** | Security Plan | | **<1** |
| | | 100.8 | Equipment Failure | Overtop pond, release of process and tails, pond liner leak . | O | A | 2 | 2 | 1 | 1 | M | A | **A, 2** | Environmental Health and Safety Plan | | **2** |
| Chemical Storage | Fuel/Oil Storage, Mill Chemicals, Explosive Storage. | 200.1 | Equipment and Operator Failure | Loss of product (10,000 gallons) | C/O | B | 3 | 3 | 1 | 2 | M | B | **B, 3** | Spill Management Plan; Environmental Health and Safety Plan | | **2** |
| Ore Handling | Conveyor | 200.2 | Fire, Equipment Failure of Conveyor | Spill of ore to ground | O | A | 1 | 1 | 1 | 1 | M | A | **A, 1** | Spill Management Plan; Environmental Health and Safety Plan | | **<1** |
| Underground Mine | Geochemistry | 300.1 | Unpredicted ARD | Exceedence of water quality standards, Increased water treatment, increased surface disturbance (waste rock management). | C/O | E | 2 | 2 | 1 | 3 | M | E | **E, 3** | | | **<1** |
| | | 300.2 | Near neutral pH - Metal Leaching - Metal Concentrations an Order of Magnitude Larger | Exceedence of water quality standards, increased water treatment, increased surface disturbance (waste rock management). | C/O | C | 2 | 2 | 1 | 3 | M | C | **C, 3** | | | **1** |
| | Vehicles, material deliveries, fuel storage, pillars, mine openings, u/g crusher, explosive storage, fuel storage. | 300.3 | Major Ground Failure | Surface Subsidence | O | E | 4 | 4 | 4 | 3 | M | E | **E, 4** | | | **<1** |
| | | 300.4 | Mine Fires/Explosion | Property Damage, Loss of Life | C/O | C | 1 | 1 | 3 | 3 | M | C | **C, 3** | Fire Control Plan | | **1** |
| | | 300.5 | Ground control - internal | Temporary Impact to Mine Operations, Loss of Life. | C/O | A | 1 | 1 | 3 | 1 | H | A | **A, 3** | | | **3** |
| | | 300.6 | Equipment Failure/Accident | Spills, Property Damage, Loss of Life | C/O | A | 1 | 1 | 3 | 1 | M | A | **A, 3** | Spill Management Plan; Environmental Health and Safety Plan | | **3** |
| | | 300.7 | Mine Inflow | Mine Flooding | C/O | D | 2 | 2 | 1 | 2 | M | D | **D, 2** | | | **<1** |
| | | 300.8 | Unpredicted Wilderness Groundwater Impacts (Order of Mag. Greater) | Decrease groundwater discharge to springs, lakes wetlands, streams | C/O | C | 4 | 4 | 3 | 2 | M | C | **C, 4** | | | **2** |
| Underground Mine/ Closure | Geochemistry | 400.1 | Post Bond Release Unpredicted ARD | Exceedence of water quality standards-springs/seeps. | P | D | 3 | 2 | 1 | 2 | M | D | **D, 3** | | | **<1** |
| | | 400.2 | Portal Plug Failure | Increased release of stored water with an exceedence of water quality standards, increased seep around the portal plug. Initial release of stored water and decrease in groundwater levels, discharge to Libby and/or Ramsey, exceedence of water quality standards, increased seep around plug, approx. 1/3 of mine openings are not flooded, decrease available water to the lakes. | P | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | | 400.3 | Post Bond Release - Near neutral pH - Metal Leaching - Metal Concentrations an Order of Magnitude Larger | Exceedence of water quality standards-springs/seeps. | P | C | 2 | 1 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | | 400.4 | Major Ground Failure | Localized Surface Subsidence | P | C | 1 | 1 | 1 | 1 | M | C | **C, 1** | | | **<1** |
| | | 400.5 | Unpredicted Wilderness Groundwater Impacts (Order of Mag. Greater) | Lower Baseflow, increased returns and shifted lower in the stream system, redistribution of groundwater flows. | P | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |

**Table I-1.2 Risk Chart - Libby Plant Site**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVEABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 - CATASTROPHIC | RISK LEVEL 1 E,5 | RISK LEVEL 2 D,5 | RISK LEVEL 3 C,5 | RISK LEVEL 4 B,5 | RISK LEVEL 5 A,5 |
| 4 - MAJOR | RISK LEVEL <1 E,4<br>300.3 | RISK LEVEL 1 D,4 | RISK LEVEL 2 C,4<br>100.5, 300.8 | RISK LEVEL 3 B,4 | RISK LEVEL 4 A,4 |
| 3 - MODERATE | RISK LEVEL <1 E,3<br>300.1 | RISK LEVEL <1 D,3<br>100.1, 400.1 | RISK LEVEL 1 C,3<br>100.6, 300.2, 300.4 | RISK LEVEL 2 B,3<br>100.2, 200.1 | RISK LEVEL 3 A,3<br>300.5, 300.6 |
| 2 - MINOR | RISK LEVEL <1 E,2 | RISK LEVEL <1 D,2<br>300.7 | RISK LEVEL <1 C,2<br>400.2, 400.3, 400.5 | RISK LEVEL 1 B,2<br>100.4 | RISK LEVEL 2 A,2<br>100.8 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E,1 | RISK LEVEL <1 D,1 | RISK LEVEL <1 C,1<br>400.4 | RISK LEVEL <1 B,1<br>100.7 | RISK LEVEL 1 A,1<br>100.3, 200.2 |

**Table I-2.1 Ramsey Plant Site**

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Ramsey Plant Site | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| Mill Facilities | Grinding circuit, coarse ore stockpile, mill/shop facilities, offices, storage areas, pond, pad/foundation. | 100.1 | Avalanche. Landslides, mass wasting, earthquake | Property damage, release of process water, mill chemicals, 1000 tons of tailings, potential loss of life. | O | D | 3 | 2 | 3 | 3 | H | D | **D, 3** | Avalanche Management Plan, Environmental Health and Safety Plan | | **<1** |
| | | 100.2 | Forest Fire | Property damage, access restriction, pipeline failure, plant shutdown, loss of life, chemical/process/tails release. | O | B | 2 | 2 | 3 | 3 | M | B | **B, 3** | Fire Control Plan | | **2** |
| | | 100.3 | Loss of Power | Temporary shutdown | O | A | 1 | 1 | 1 | 1 | H | A | **A, 1** | | | **<1** |
| | | 100.4 | Flood (Rain on Snow Event) | Pond overflow, property damage, Erosion. | O | B | 2 | 2 | 1 | 1 | H | B | **B, 2** | Environmental Health and Safety Plan | | **1** |
| | | 100.5 | Plant Fire - Wildfire | Habitat loss (wildfire), loss of life, shutdown the operations, erosion,. | C/O | C | 3 | 4 | 4 | 3 | M | C | **C, 4** | Fire Control Plan | | **2** |
| | | 100.6 | Plant Fire - Internal | Property damage, loss of life, temporary shutdown | C/O | C | 1 | 1 | 3 | 1 | M | C | **C, 3** | Fire Control Plan | | **1** |
| | | 100.7 | Vandalism | Property damage | C/O | B | 1 | 1 | 1 | 1 | M | B | **B, 1** | Security Plan | | **<1** |
| | | 100.8 | Equipment Failure | Overtop pond, release of process and tails, pond liner leak . | O | A | 2 | 2 | 1 | 1 | M | A | **A, 2** | Environmental Health and Safety Plan | | **2** |
| Chemical Storage | Fuel/Oil Storage, Mill Chemicals, Explosive Storage. | 200.1 | Equipment and Operator Failure | Loss of Product (10,000 gallons) | C/O | B | 3 | 3 | 1 | 2 | M | B | **B, 3** | Spill Management Plan; Environmental Health and Safety Plan | | **2** |
| Ore Handling | Conveyor | 200.2 | Fire, Equipment Failure of Conveyor | Spill of Ore to Creek | O | B | 1 | 1 | 1 | 1 | M | B | **B, 1** | Spill Management Plan; Environmental Health and Safety Plan | | **<1** |
| Underground Mine | Geochemistry | 300.1 | Unpredicted ARD | Exceedence of water quality standards, Increased water treatment, increased surface disturbance (waste rock management). | C/O | E | 2 | 2 | 1 | 3 | M | E | **E, 3** | | | **<1** |
| | | 300.2 | Near neutral pH - Metal Leaching - Metal Concentrations an Order of Magnitude Larger | Exceedence of water quality standards, increased water treatment, increased surface disturbance (waste rock management) | C/O | C | 2 | 2 | 1 | 3 | M | C | **C, 3** | | | **1** |
| | Vehicles, material deliveries, fuel storage, pillars, mine openings, u/g crusher, explosive storage, fuel storage. | 300.3 | Major Ground Failure | Surface Subsidence | O | E | 4 | 4 | 4 | 3 | M | E | **E, 4** | | | **<1** |
| | | 300.4 | Mine Fires/Explosion | Property Damage, Loss of Life | C/O | C | 1 | 1 | 3 | 3 | M | C | **C, 3** | Fire Control Plan | | **1** |
| | | 300.5 | Ground control - internal | Temporary Impact to Mine Operations, Loss of Life | C/O | A | 1 | 1 | 3 | 1 | H | A | **A, 3** | | | **3** |
| | | 300.6 | Equipment Failure/Accident | Spills, Property Damage, Loss of Life | C/O | A | 1 | 1 | 3 | 1 | M | A | **A, 3** | Spill Management Plan; Environmental Health and Safety Plan | | **3** |
| | | 300.7 | Mine Inflow | Mine Flooding | C/O | D | 2 | 2 | 1 | 2 | M | D | **D, 2** | | | **<1** |
| | | 300.8 | Unpredicted Wilderness Groundwater Impacts (Order of Mag. Greater) | Decrease groundwater discharge to springs, lakes wetlands, streams. | C/O | C | 4 | 4 | 3 | 2 | M | C | **C, 4** | | | **2** |
| Underground Mine/ Closure | Geochemistry | 400.1 | Post Bond Release Unpredicted ARD | Exceedence of water quality standards springs/seeps. | P | D | 3 | 2 | 1 | 2 | M | D | **D, 3** | | | **<1** |
| | | 400.2 | Portal Plug Failure | Increased release of stored water with an exceedence of water quality standards, increased seep around the portal plug. Initial release of stored water and decrease in groundwater levels, discharge to Libby and/or Ramsey, exceedence of water quality standards, increased seep around plug, approx. 1/3 of mine openings are not flooded, decrease available water to the lakes. | P | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | | 400.3 | Post Bond Release - Near neutral pH - Metal Leaching - Metal Concentrations an Order of Magnitude Larger | Exceedence of water quality standards-springs/seeps | P | C | 2 | 1 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | | 400.4 | Major Ground Failure | Localized Surface Subsidence | P | C | 1 | 1 | 1 | 1 | M | C | **C, 1** | | | **<1** |
| | | 400.5 | Unpredicted Wilderness Groundwater Impacts (Order of Mag. Greater) | Lower Baseflow, increased returns and shifted lower in the stream system, redistribution of groundwater flows. | P | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |

**Table I-2.2 Risk Chart - Ramsey Plant Site**

| CONSEQUENCE | LIKELIHOOD: E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
|---|---|---|---|---|---|
| 5 -CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4<br>300.3 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4<br>100.5, 300.8 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| 3 - MODERATE | RISK LEVEL <1 E, 3<br>300.1 | RISK LEVEL <1 D, 3<br>100.1, 400.1 | RISK LEVEL 1 C, 3<br>100.6, 300.2, 300.4 | RISK LEVEL 2 B, 3<br>100.2, 200.1 | RISK LEVEL 3 A, 3<br>300.5, 300.6 |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2<br>300.7 | RISK LEVEL <1 C, 2<br>400.2, 400.3, 400.5 | RISK LEVEL 1 B, 2<br>100.4 | RISK LEVEL 2 A, 2<br>100.8 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1 | RISK LEVEL <1 C, 1<br>400.4 | RISK LEVEL <1 B, 1<br>100.7, 200.2 | RISK LEVEL 1 A, 1<br>100.3 |

## Table I-3.1 TSF Tailings Impoundment (Proposed Design) - Little Cherry Creek

| PROJECT AREA: | MONTANORE | | | | | | | | | | | | | DATE LAST MODIFIED: | September 23, 2008 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 - TSF Tailings Impoundment (Proposed Design) - Little Cherry Creek | | | | | | | | | | | | | | | |
| MONTANORE PROJECT - El. 3710 FT (PROPOSED DESIGN) | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | | |
| COMPONENT/SUB-COMPONENT | I. D. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD* | RISK PARAMETERS (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK PARAMETERS (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL | |
| **100 SERIES DAM SAFETY MAIN DAM** | | | | | | | | | | | | | | | | |
| Filters, Drains, Fill, Foundation | 100.1 | Pore pressures in glaciolacustrine clay are higher than predicted. | Reduction in stability requiring additional shear keys or slope flattening. | C/O | C | 1 | 1 | 1 | 3 | M | C | C, 3 | Piezometers to measure pressures, risk reduces with time as clay consolidates. | | **1** | |
| | 100.2 | Higher than expected uplift pressures | Reduction in stability - dam failure | C/O | C | 1 | 1 | 1 | 1 | M | C | C, 1 | Monitor and install pressure relief wells and/or flatten the dam slopes. | | **<1** | |
| | 100.3 | Loose glacial outwash layer liquefies under seismic loading. | Reduction in stability - dam failure | O/CL | D | 5 | 5 | 5 | 5 | M | D | D, 5 | Conservative design - portion of foundation could liquefy and factor of safety would still be >1.0. | | **2** | |
| | 100.4 | Tailings dam underdrains plug causing higher than expected pore pressures in dam. | Rise in water table in the cyclone sand fill, small reduction in factor of safety. | O/CL | C | 1 | 1 | 1 | 2 | M | C | C, 2 | Monitor pore pressures in the dam and flatten slopes, if required. | | **<1** | |
| | 100.5 | Tailings impoundment underdrains plug, with time. | Uplift pressures in dam foundation increase- reducing the stability. | O/CL | C | 1 | 1 | 1 | 2 | L | B | B, 2 | Monitor pore pressures in dam foundation and flatten slopes, if required. | | **1** | |
| | 100.6 | Decreased efficiency of cyclones. | Higher fines content requires more compactive effort and/or the use of outside borrow. | O | C | 1 | 1 | 1 | 2 | M | C | C, 2 | Monitor cyclone performance and adjust cyclones to suit any changes in ore. cycle cyclone operations to allow longer time to "drain". | | **<1** | |
| | 100.7 | Inadequate quantity of cyclone sand either due to poor cyclone performance or flatter dam slopes. | Require borrow material, higher cost | O | C | 1 | 1 | 1 | 2 | M | C | C, 2 | Increase cyclone plant recovery; experiment with quality vs. recovery for downstream; expand plant for new tonnage. | | **<1** | |
| **200 SERIES IMPOUNDMENT & WATER QUALITY** | | | | | | | | | | | | | | | | |
| Tailings Beach, Reservoir Slope, Decant, Seepage Pond, Tails Storage/ Pond Level | 200.1 | Underdrains plug | Head buildup in impoundment - increased loading to groundwater of ~ 50%. | O | C | 2 | 2 | 1 | 1 | M | C | C, 2 | Monitor & install seepage collection wells. monitor water quality and install pumpback wells if required. increase is within range of accuracy of estimate. | | **<1** | |
| | 200.2 | "Natural" groundwater spring (s) "feed" directly into the underdrain system. | Increases water reclaim over the requirement - requiring discharge or treatment of excess water. | O/CL | C | 1 | 1 | 1 | 1 | M | C | C, 1 | Monitor water quality and iinstall additional water reclaim/pumpback facilities, if required. | | **<1** | |
| | 200.3 | Tailings permeability is higher than design | Increased seepage loss to foundation groundwater (bypasses underdrains) of ~ 30% requires water treatment and/or pumpback wells. | O/CL | C | 2 | 1 | 1 | 1 | L | B | B, 2 | Monitor & install seepage collection wells. increase is within range of accuracy of estimate. | | **1** | |
| | 200.4 | Decant water pond "moves" over the pervious native material or underdrains. | Increased seepage loss to foundation groundwater (bypasses underdrains) of ~ 30%. | O | C | 2 | 1 | 1 | 1 | L | B | B, 2 | Monitor pond location to maintain location away from natural soils. Modifiy spigotting of tailings to ensure coverage of natural soils. | | **1** | |
| | 200.5 | "Loss" of water from underdrains into the foundation groundwater. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 1 | L | B | B, 2 | Baseline groundwater flow is about 50 gpm, well within the water balance requirements. | | **1** | |
| | 200.6 | "Pervious" soil connection between tailings and bedrock aquifer. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 3 | L | B | B, 3 | Monitor water quality and iinstall additional water reclaim/pumpback facilities, if required. | | **2** | |
| | 200.7 | "Pervious" soil connection between "failed" main trunk underdrain to bedrock aquifer. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 2 | L | B | B, 2 | Monitor water quality and install additional water reclaim/pumpback facilities, if required. | | **1** | |
| | 200.8 | "Unknown" aquifer connection through buried channel to libby creek. | Increase in contaminant loading to libby creek. | O/CL | C | 2 | 2 | 1 | 2 | L | B | B, 2 | Monitor water quality and install additional water reclaim/pumpback facilities, if required. | | **1** | |
| | 200.9 | Inadequate freeboard | Overflow of water and discharge of tailings to surface water. | O | D | 3 | 3 | 3 | 3 | M | D | D, 3 | Tailings water balance and freeboard managed; construct temporary berm or shut down operations. | | **<1** | |
| | 200.10 | "Unknown" aquifer connection to former little cherry creek. | Increase in contaminant loading to former l. cherry. | O/CL | C | 3 | 2 | 1 | 2 | L | B | B, 3 | Monitoring and seepage interception wells, as required. | | **2** | |
| **300 SERIES TAILINGS, SURFACE WATER AND ASSOCIATED STRUCTURES** | | | | | | | | | | | | | | | | |
| Pump Barges, Pump Back Systems, Pumping, Diversion Channel, Tailings Pipeline, Cyclone Stations, Thickeners | 300.1 | Tailings water reclaim pipeline break. | Spill of tailings slurry | O | B | 2 | 2 | 2 | 2 | M | B | B, 2 | Pressure sensors, lined ditch, emergency storage at low points. | | **1** | |
| | 300.2 | Pump barge breakdown for extended time. | Increases pond level, which could direct water into underdrains. | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Emergency backup pumps would be installed. | | **<1** | |
| | 300.3 | Shutdown of thickener for extended time. | Increase in water delivered to impoundment and to be pumped back. | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Install additional emergency pumping capacity. | | **<1** | |
| | 300.4 | Seepage collection system breakdown for extended time. | Exceeds storage capacity of facility and requires discharge. | O | C | 3 | 3 | 1 | 1 | M | C | C, 3 | Backup pumps for contingencies | | **1** | |
| | 300.5 | Diversion channel blockage below impoundment fac. | Increase of sediment loading for a short duration. | O | C | 2 | 2 | 1 | 1 | M | C | C, 2 | Repair sections | | **<1** | |
| | 300.6 | Diversion channel blockage | Plugs outlet and water overtops diversion dam into impoundment. | O/P | D | 1 | 1 | 1 | 1 | H | D | D, 1 | Conservative design of channel capacity, maintenance; increase freeboard on dam to store additional water until diversion repaired. | | **<1** | |
| **400 SERIES CLOSURE** | | | | | | | | | | | | | | | | |
| Covers, Closure Spillway, Water Treatment Plant, Final Dam, Diversion | 400.1 | Tailing too soft to reclaim | Increase cost to reclaim, increased borrow sources. | P | B | 1 | 1 | 1 | 2 | H | B | B, 2 | Use geotextiles & cycloned sand mat | | **1** | |
| | 400.2 | Unsuccessful revegetation | Additional costs | P | C | 1 | 1 | 1 | 1 | M | C | C, 1 | Test plots before closure | | **<1** | |
| | 400.3 | Erosion due to extreme precipitation | Sediment load to libby creek | P | B | 2 | 2 | 1 | 1 | M | A | A, 2 | Design, monitoring and repair of eroded sections | | **2** | |
| | 400.4 | Underdrainage & surface water contaminated | Exceedence of water quality standards | P | E | 3 | 3 | 1 | 2 | L | D | D, 3 | Monitoring and water treatment | | **1** | |
| | 400.5 | Groundwater contamination | Degrades groundwater quality of downstream users. | P | E | 2 | 1 | 1 | 2 | L | D | D, 2 | Monitoring and water treatment | | **<1** | |
| | 400.6 | ARD from tailings | Degradation of water quality in receiving surface water. | P | E | 3 | 3 | 1 | 2 | M | D | D, 3 | Monitoring and water treatment | | **<1** | |
| | 400.7 | Diversion failure | Increased sediment and discharge to surface water. | P | D | 2 | 2 | 1 | 1 | M | C | C, 2 | Monitoring and repair | | **<1** | |
| | 400.8 | ARD from waste rock used for construction | Degradation of water quality in receiving surface water. | P | D | 2 | 2 | 1 | 2 | M | C | C, 2 | ARD testing of waste rock prior to use. Remove waste rock; localized collection and treatment of leachate. | | **<1** | |
| *Components that will have residual risk of failure at closure have had liklihood of failure increased one level | | | | | | | | | | | | | | | | |

**Table I-3.2 Risk Chart - TSF Tailings Impoundment (Proposed Design) - Little Cherry Creek**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 -CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| | | 100.3 | | | |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| | | | | | |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3 | RISK LEVEL 1 C, 3 | RISK LEVEL 2 B, 3 | RISK LEVEL 3 A, 3 |
| | | 200.9, 400.4, 400.6 | 100.1, 300.4 | 200.6, 200.10 | |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2 | RISK LEVEL 1 B, 2 | RISK LEVEL 2 A, 2 |
| | | 400.5 | 100.4, 100.6, 100.7, 200.1, 300.5, 400.7, 400.8 | 100.5, 200.3, 200.4, 200.5, 200.7, 200.8, 300.1, 400.1 | 400.3 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1 | RISK LEVEL <1 C, 1 | RISK LEVEL <1 B, 1 | RISK LEVEL 1 A, 1 |
| | | 300.6 | 100.2, 200.2, 400.2 | 300.2, 300.3 | |

**Table I-4.1 Poorman Tailings Impoundment Alternative**

| PROJECT | MONTANORE | | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Poorman Tailings Impoundment Alternative | | | | | | | | | | | | | | | | |
| | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | | | |
| COMPONENT/SUB-COMPONENT | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD* | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| **100 SERIES DAM SAFETY MAIN DAM** | | | | | | | | | | | | | | | |
| Filters, Drains, Fill, Foundation | 100.1 | Unexpected weak materials encountered at tailings dam foundation. | Reduction in stability requiring additional shear keys or slope flattening, potential impacts to private landowner. | C/O | C | 1 | 1 | 4 | 3 | M | C | C, 4 | Piezometers to measure pressures, risk reduces with time as clay consolidates. | | **2** |
| | 100.2 | Unexpected loose material at tailings dam foundation liquefies under seismic loading. | Reduction in stability - dam failure. | O/CL | D | 5 | 5 | 5 | 5 | H | D | D, 5 | Conservative design - portion of foundation could liquefy and factor of safety would still be >1.0. | | **2** |
| | 100.3 | Tailings dam underdrains plug causing higher than expected pore pressures in dam. | Rise in water table in the cyclone sand fill, small reduction in factor of safety. | CL | C | 1 | 1 | 1 | 2 | M | C | C, 2 | | | **<1** |
| | 100.4 | Decreased efficiency of the cyclones. | More compactive effort and more borrow material. | O | C | 1 | 1 | 1 | 2 | M | C | C, 2 | Increase cyclone plant recovery; experiment with quality vs recovery for downstream; expand plant for new tonnage. | | **<1** |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| **200 SERIES IMPOUNDMENT & WATER QUALITY** | | | | | | | | | | | | | | | |
| Tailings Beach, Reservoir Slope, Decant, Seepage Pond, Tails Storage/Pond Level | 200.1 | Underdrains plug | Head buildup in impoundment - increased loading to groundwater of ~ 50%. | O | C | 2 | 2 | 1 | 1 | M | C | C, 2 | Increase is within range of accuracy of estimate, monitor & install seepage collection wells. | | **<1** |
| | 200.2 | "Natural" groundwater spring (s) "feed" directly into the underdrain system. | Increases water reclaim over the requirement - requiring discharge or treatment of excess water. | O/CL | C | 1 | 1 | 1 | 1 | M | C | C, 1 | | | **<1** |
| | 200.3 | Tailings permeability is higher than design. | Increased seepage loss to foundation groundwater (bypasses underdrains) of ~ 30%. | O/CL | C | 2 | 1 | 1 | 1 | L | B | B, 2 | Increase is within range of accuracy of estimate, monitor & install seepage collection wells. | | **1** |
| | 200.4 | Decant water pond "moves" over the pervious native material or under. | Increased seepage loss to foundation groundwater (bypasses underdrains) of ~ 30%. | O | C | 2 | 1 | 1 | 1 | L | B | B, 2 | | | **1** |
| | 200.5 | "Loss" of water from underdrains into the foundation groundwater. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 1 | L | B | B, 2 | Baseline groundwater flow is about 50 gpm, well within the water balance requirements. | | **1** |
| | 200.6 | "Pervious" soil connection between tailings and bedrock aquifer. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 3 | L | B | B, 3 | Monitoring | | **2** |
| | 200.7 | "Pervious" soil connection between "failed" main trunk underdrain to bedrock aquifer. | Increase in contaminant loading to foundation groundwater. | O/CL | C | 2 | 1 | 1 | 2 | L | B | B, 2 | Main trunk drains will be lined | | **1** |
| | 200.8 | "Unknown" aquifer connection through buried channel to libby creek. | Increase in contaminant loading to libby creek. | O/CL | C | 2 | 2 | 1 | 2 | L | B | B, 2 | Monitoring and seepage interception wells, as required. | | **1** |
| | 200.9 | Inadequate freeboard | Overflow of water and discharge of tailings to surface water. | O | D | 3 | 3 | 3 | 3 | M | D | D, 3 | Tailings water balance and freeboard managed | | **<1** |
| | 200.10 | "Unknown" aquifer connection to former little cherry creek. | Increase in contaminant loading to former l. cherry. | O/CL | C | 3 | 2 | 1 | 2 | L | B | B, 3 | Monitoring and seepage interception wells, as required. | | **2** |
| | 200.11 | Foundation more permeable than predicted. | Increase in contaminant loading. | O/CL | C | 2 | 2 | 3 | 3 | L | B | B, 3 | Site investigation pumpback wells | | **2** |
| | 200.12 | Deposited densities less than predicted. | Insufficient storage capacity - need a new site. | O | C | 2 | 2 | 3 | 3 | L | B | B, 3 | Detailed design | | **2** |
| | 200.13 | Mechanical breakdown of thickeners or pumping system. | Plant shutdown or placement of wet tailings. | O | B | 1 | 1 | 1 | 2 | M | B | B, 2 | Design | | **1** |
| **300 SERIES TAILINGS, SURFACE WATER AND ASSOCIATED STRUCTURES** | | | | | | | | | | | | | | | |
| Pump Barges, Pump Back Systems, Pumping, Tailings Pipeline, Cyclone Stations, Thickeners | 300.1 | Tailings or water reclaim pipeline break. | Pipeline breaks more likely because of the greater amount of infrastructure needed to sustain the paste and cyclone operations. the risk of significant damage is unlikely. | O | A | 2 | 2 | 2 | 2 | M | A | A, 2 | Pressure sensors, lined ditch, emergency storage at low points | | **2** |
| | 300.2 | Breakdown of barge pump for extended time. | Increases pond level, which could direct water into underdrains. | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Backup pumps | | **<1** |
| | 300.3 | Shutdown of thickener for extended time. | Increase in water delivered to impoundment and to be pumped back. | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Reclaim water capacity in impoundment | | **<1** |
| | 300.4 | Seepage collection system breakdown for extended time. | Exceeds storage capacity of facility and requires discharge. | O | C | 3 | 3 | 1 | 1 | M | C | C, 3 | Backup pumps for contingencies | | **1** |
| | 300.5 | Dust emissions from dry tailings. | Blown dust may impact water quality of libby creek and air quality of private land. mine shutdown or legal dispute. | O | D | 2 | 2 | 2 | 5 | M | D | D, 5 | Dust control with sprinklers and compensation plan with landowner | | **2** |
| | 300.6 | Noise pollution from mechanical equipment. | Noise will be generated by heavy machinery during cyclone operation and other construction activities. mine shutdown or legal dispute. | O | D | 1 | 1 | 2 | 5 | M | D | D, 5 | Noise controls and compensation plan for landowner | | **2** |
| | 300.7 | Dust emissions | Affect local landowner | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Dust control with sprinkler | | **<1** |
| | 300.8 | Noise | Affect local landowner | O | B | 1 | 1 | 1 | 1 | M | B | B, 1 | Operate equipment only on day shift | | **<1** |
| **400 SERIES CLOSURE** | | | | | | | | | | | | | | | |
| Covers, Closure Spillway, Water Treatment Plant, Final Dam | 400.1 | Tailing too soft to reclaim | Increase cost to reclaim, increased borrow sources | P | B | 1 | 1 | 1 | 2 | H | B | B, 2 | Use geotextiles & cycloned sand mat | | **1** |
| | 400.2 | Unsuccessful revegetation | Additional costs | P | C | 1 | 1 | 1 | 1 | M | C | C, 1 | Test plots before closure | | **<1** |
| | 400.3 | Erosion due to extreme precipitation | Sediment load to bear creek from channel | P | B | 2 | 2 | 1 | 1 | M | A | A, 2 | Design, monitoring | | **2** |
| | 400.4 | Underdrainage & surface water contaminated | Exceedence of water quality standards | P | E | 3 | 3 | 1 | 2 | L | C | C, 3 | Monitoring and water treatment | | **1** |
| | 400.5 | Groundwater contamination | Requires pumpback wells and water treatment | P | D | 2 | 1 | 3 | 4 | M | C | C, 4 | Monitoring | | **2** |
| | 400.6 | ARD from tailings | Degradation of water quality, possibly requiring treatment | P | E | 3 | 3 | 3 | 3 | M | D | D, 3 | | | **<1** |
| | 400.7 | ARD from waste rock used for construction | degradation of water quality, possibly requiring treatment | P | D | 2 | 2 | 3 | 3 | M | C | C, 3 | ARD testing of waste rock prior to use | | **1** |

*Components that will have residual risk of failure at closure have had liklihood of failure increased one level

**Table I-4.2 Risk Chart - Poorman Tailings Impoundment**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 -CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5<br>100.2, 300.5, 300.6 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4<br>100.1, 400.5 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3<br>200.9, 400.6 | RISK LEVEL 1 C, 3<br>300.4, 400.4, 400.7 | RISK LEVEL 2 B, 3<br>200.6, 200.10, 200.11, 200.12 | RISK LEVEL 3 A, 3 |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2<br>100.3, 100.4, 200.1 | RISK LEVEL 1 B, 2<br>200.3, 200.4, 200.5, 200.7, 200.8, 200.13, 400.1 | RISK LEVEL 2 A, 2<br>300.1, 400.3 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1 | RISK LEVEL <1 C, 1<br>200.2, 400.2 | RISK LEVEL <1 B, 1<br>300.2, 300.3, 300.7, 300.8 | RISK LEVEL 1 A, 1 |

## Table I-5.1 Roads, Pipelines, Loadout and LAD's

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Roads, Pipelines, Loadout and LAD's | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| | | | | | | | | | | | | | | | | |
| Main Access Road and other Secondary Mine Access Roads | Truck Traffic/Deliveries (Petroleum, Reagents, Explosives), Concentrate Haulage | 100.1 | Accident/Equipment Failure | Spills | C/O | A | 1 | 1 | 1 | 1 | H | A | **A, 1** | Environmental Health and Safety Plan | | **<1** |
| | | 100.2 | Accident/Equipment Failure | Spills in RHCA | C/O | C | 3 | 3 | 1 | 1 | M | C | **C, 3** | Environmental Health and Safety Plan | | **1** |
| | Transportation | 100.3 | Accident | Wildlife Mortality | C/O | A | 1 | 1 | 1 | 1 | H | A | **A, 1** | Environmental Health and Safety Plan | | **<1** |
| | Transportation | 100.4 | Accident | Wildlife Mortality (T&E Species) | C/O | C | 1 | 4 | 2 | 2 | M | C | **C, 4** | Environmental Health and Safety Plan | | **2** |
| | Road Failure | 100.5 | Avalanche, Landslides etc. | Sediment Loading | C/O | C | 2 | 1 | 1 | 1 | M | C | **C, 2** | Environmental Health and Safety Plan | | **<1** |
| | | | | | | | | | | | | | | | | |
| Pipelines and Utility Corridors | Tailings Pipeline | 200.1 | Failure, Accident | Spills | O | B | 1 | 1 | 1 | 1 | M | B | **B, 1** | Operations, Maintenance and Surveillance Manual | | **<1** |
| | | 200.2 | Failure, Accident | Spills In an RHCA | O | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | Operations, Maintenance and Surveillance Manual | | **<1** |
| | | 200.3 | Avalanche, Landslides etc. | Spills In an RHCA | O | C | 2 | 2 | 1 | 1 | M | C | **C, 2** | Operations, Maintenance and Surveillance Manual | | **<1** |
| | | | | | | | | | | | | | | | | |
| Haulage and Transport | Haul Trucks and Equipment, Rail Car, Storage/Transport to Main Rail Line | 300.1 | Spill Concentrate | Local Soil Contamination | O | D | 1 | 1 | 1 | 1 | M | D | **D, 1** | Environmental Health and Safety Plan | | **<1** |
| | | | | | | | | | | | | | | | | |
| LAD Areas | Soil stockpiles, waste rock, sediment traps, diversion ditches | 400.1 | Block Ditches | Sediment Loading, Nitrate | C/O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Environmental Health and Safety Plan | | **1** |
| | Environmental Health and Safety Plan | 400.2 | Equipment Failure/Operator Error, Preferential Flow/LAD | Increase Metal and Nutrient Level (Surface/Ground. Water), Sediment Loading | C/O | A | 2 | 2 | 1 | 1 | M | A | **A, 2** | Environmental Health and Safety Plan; develop new LAD area | | **2** |
| | | 400.3 | Exceedence of Application Rate | Increase Metal and Nutrient Level (Surface/Ground. Water), Sediment Loading, Water Treatment or Additional LAD | C/O | C | 3 | 3 | 1 | 2 | M | C | **C, 3** | Environmental Health and Safety Plan | | **1** |

**Table I-5.2 Risk Chart - Roads, Pipelines, Loadout and LAD's**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 - CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4<br>100.4 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3 | RISK LEVEL 1 C, 3<br>100.2, 400.3 | RISK LEVEL 2 B, 3 | RISK LEVEL 3 A, 3 |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2<br>100.5, 200.2, 200.3 | RISK LEVEL 1 B, 2<br>400.1 | RISK LEVEL 2 A, 2<br>400.2 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1<br>300.1 | RISK LEVEL <1 C, 1 | RISK LEVEL <1 B, 1<br>200.1 | RISK LEVEL 1 A, 1<br>100.1, 100.3 |

## Table I-6.1 Transmission Line - Proposed North Miller Route

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Transmission Line - Proposed North Miller Route | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| **Construction** | | | | | | | | | | | | | | | | |
| Transmission Line Construction | Equipment | 100.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.2 | Mobile construction equip. accidents or failures. | Wildfire, timber value loss, sediment loading. | C | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | Poles, Structures, Lines | 100.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 100.5 | Construction Technique Failures | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| **Operation** | | | | | | | | | | | | | | | | |
| Routine Operation | Inspection and Repair Process | 200.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | | | **1** |
| | | 200.2 | Crash, heli Failure. and/or lighting strikes to poles (specific to inspection.). | Wildfire, timber value loss | O | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 200.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | O | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | | | **<1** |
| | Roads, Structures, Poles, Communications | 200.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 200.5 | Wildlife Equipment Destruction | Loss of a pole and power | O | D | 1 | 1 | 1 | 1 | M | D | **D, 1** | | | **<1** |
| | | | | | | | | | | | | | | | | |
| Sedlak Park Substation | Substation and loop line | 300.1 | Vandalism, earthquake | Loss of Power | O | C | 1 | 1 | 1 | 1 | M | C | **C, 1** | | | **<1** |

**Table I-6.2 Risk Chart - Transmission Line Proposed North Miller Route**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 -CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3 | RISK LEVEL 1 C, 3<br>100.2, 200.2 | RISK LEVEL 2 B, 3 | RISK LEVEL 3 A, 3 |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2<br>100.3, 100.5, 200.3 | RISK LEVEL 1 B, 2<br>100.1, 100.4, 200.1, 200.4 | RISK LEVEL 2 A, 2 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1<br>200.5 | RISK LEVEL <1 C, 1<br>300.1 | RISK LEVEL <1 B, 1 | RISK LEVEL 1 A, 1 |

## Table I-7.1 Transmission Line Alternative - Modified North Miller

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Transmission Line Alternative - Modified North Miller | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| **Construction** | | | | | | | | | | | | | | | | |
| Transmission Line Construction | Equipment | 100.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.2 | Mobile construction equip. accidents or failures. | Wildfire, timber value loss, sediment loading. | C | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| | Poles, Structures, Lines | 100.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 100.5 | Construction Technique Failures | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| **Operation** | | | | | | | | | | | | | | | | |
| Routine Operation | Inspections, Repairs | 200.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 200.2 | Failure and/or lighting strikes to poles. | Wildfire, timber value loss | O | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 200.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | O | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Environmental Health and Safety Plan | | **<1** |
| | Roads, Structures, Poles, Communications | 200.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 200.5 | Wildlife Equipment Destruction | Loss of a pole and power | O | D | 1 | 1 | 1 | 1 | M | D | **D, 1** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| | | | | | | | | | | | | | | | | |
| Sedlak Park Substation | Substation and loop line | 300.1 | Vandalism, earthquake | Loss of Power | O | C | 1 | 1 | 1 | 1 | M | C | **C, 1** | | | **<1** |

**Table I-7.2 Risk Chart - Transmission Line Alternative - Modified North Miller**

| CONSEQUENCE | LIKELIHOOD | | | | |
|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | D - UNLIKELY | C - POSSIBLE | B - LIKELY | A - ALWAYS CERTAIN |
| 5 -CATASTROPHIC | RISK LEVEL 1 E, 5 | RISK LEVEL 2 D, 5 | RISK LEVEL 3 C, 5 | RISK LEVEL 4 B, 5 | RISK LEVEL 5 A, 5 |
| 4 - MAJOR | RISK LEVEL <1 E, 4 | RISK LEVEL 1 D, 4 | RISK LEVEL 2 C, 4 | RISK LEVEL 3 B, 4 | RISK LEVEL 4 A, 4 |
| 3 - MODERATE | RISK LEVEL <1 E, 3 | RISK LEVEL <1 D, 3 | RISK LEVEL 1 C, 3<br>100.2, 200.2 | RISK LEVEL 2 B, 3 | RISK LEVEL 3 A, 3 |
| 2 - MINOR | RISK LEVEL <1 E, 2 | RISK LEVEL <1 D, 2 | RISK LEVEL <1 C, 2<br>100.3, 100.5, 200.3 | RISK LEVEL 1 B, 2<br>100.1, 100.4, 200.1, 200.4 | RISK LEVEL 2 A, 2 |
| 1 - INSIGNIFICANT | RISK LEVEL <1 E, 1 | RISK LEVEL <1 D, 1<br>200.5 | RISK LEVEL <1 C, 1<br>300.1 | RISK LEVEL <1 B, 1 | RISK LEVEL 1 A, 1 |

## Table I-8.1 Transmission Line Alternative - West Fisher Creek

| PROJECT | MONTANORE | | | | | | | | | | DATE LAST MODIFIED: | | | September 23, 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA: | Transmission Line Alternative - West Fisher Creek | | | | | | | | | | | | | | | |
| | | | | | | | CONSEQUENCES | | | | CONFIDENCE | | | | | |
| COMPONENT/SUB-COMPONENT | | ID. No. | FAILURE MODE AND CAUSE (WHAT IF?) | EFFECTS | PROJECT STAGE | LIKELIHOOD | WATER QUALITY | BIOPHYSICAL | COMMUNITY/ SOCIAL | COST | LEVEL OF CONFIDENCE | ADJUSTED LIKELIHOOD | RISK LEVEL (ADJUSTED FOR LEVEL OF CONFIDENCE) | COMPENSATING FACTORS AND ADEQUACY OF EXISTING CONTROLS | REDUCED RISK LEVEL (ADJUSTED FOR COMPENSATING FACTORS) | RISK LEVEL |
| **Construction** | | | | | | | | | | | | | | | | |
| Transmission Line Construction | Equipment | 100.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.2 | Mobile construction equip. accidents or failures. | Wildfire, timber value loss, sediment loading. | C | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 100.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| | Poles, Structures, Lines | 100.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | C | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 100.5 | Construction Technique Failures | Wildlife Mortalities and displacement, increased disturbance. | C | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| **Operation** | | | | | | | | | | | | | | | | |
| Routine Operation | Inspections, Repairs | 200.1 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss. | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 200.2 | Failure and/or lighting strikes to poles | Wildfire, timber value loss | O | C | 1 | 2 | 1 | 3 | M | C | **C, 3** | Fire Control Plan; Environmental Health and Safety Plan | | **1** |
| | | 200.3 | Accident | Wildlife Mortalities and displacement, increased disturbance. | O | C | 1 | 2 | 1 | 1 | M | C | **C, 2** | Environmental Health and Safety Plan | | **<1** |
| | Roads, Structures, Poles, Communications | 200.4 | Vandalism, Weather, Wildland Fires, Landslide/Avalanche, culvert failures. | Wildlife Mortalities and displacement, sediment loading, power loss | O | B | 2 | 2 | 1 | 1 | M | B | **B, 2** | Wildlife Management Plan; Environmental Health and Safety Plan; Fire Control Plan | | **1** |
| | | 200.5 | Wildlife Equipment Destruction | Loss of a pole and power | O | D | 1 | 1 | 1 | 1 | M | D | **D, 1** | Wildlife Management Plan; Environmental Health and Safety Plan | | **<1** |
| | | | | | | | | | | | | | | | | |
| Sedlak Park Substation | Substation and loop line | 300.1 | Vandalism, earthquake | Loss of Power | O | C | 1 | 1 | 1 | 1 | M | C | **C, 1** | | | **<1** |

**Table I-8.2 Risk Chart - Transmission Line Alternative - West Fisher Creek**

| CONSEQUENCE | LIKELIHOOD | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | E - CONCEIVABLE BUT IMPROBABLE | | D - UNLIKELY | | C - POSSIBLE | | B - LIKELY | | A - ALWAYS CERTAIN | |
| 5 -CATASTROPHIC | RISK LEVEL 1 | E, 5 | RISK LEVEL 2 | D, 5 | RISK LEVEL 3 | C, 5 | RISK LEVEL 4 | B, 5 | RISK LEVEL 5 | A, 5 |
| 4 - MAJOR | RISK LEVEL <1 | E, 4 | RISK LEVEL 1 | D, 4 | RISK LEVEL 2 | C, 4 | RISK LEVEL 3 | B, 4 | RISK LEVEL 4 | A, 4 |
| 3 - MODERATE | RISK LEVEL <1 | E, 3 | RISK LEVEL <1 | D, 3 | RISK LEVEL 1 | C, 3 | RISK LEVEL 2 | B, 3 | RISK LEVEL 3 | A, 3 |
| | | | | | 100.2, 200.2 | | | | | |
| 2 - MINOR | RISK LEVEL <1 | E, 2 | RISK LEVEL <1 | D, 2 | RISK LEVEL <1 | C, 2 | RISK LEVEL 1 | B, 2 | RISK LEVEL 2 | A, 2 |
| | | | | | 100.3, 100.5, 200.3 | | 100.1, 100.4, 200.1, 200.4 | | | |
| 1 - INSIGNIFICANT | RISK LEVEL <1 | E, 1 | RISK LEVEL <1 | D, 1 | RISK LEVEL <1 | C, 1 | RISK LEVEL <1 | B, 1 | RISK LEVEL 1 | A, 1 |
| | | | 200.5 | | 300.1 | | | | | |